AUTOMOTIVE INDUSTRIES

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September Schedule 155,000

August Sales Shoot Up 10 To 30 Per Cent At Close

by Athel F. Denham
Detroit Editor, Automotive Industries

A definite upturn in sales of passenger cars and trucks domestically was recorded in the closing week of August, the gains ranging from 10 to 30 per cent for various makes over previous periods. Apparently, however, the increase in sales has had little effect in boosting September schedules which at the present time aggregate about 155,000 to 160,000 cars and trucks as compared with some 230,000 units in August.

The September schedule represents a material decline under September of last year when some 202,000 vehicles were produced.

The upturn in sales seems to have been of a fairly national character, almost every district showing an increase at the month's end over earlier weeks. Used cars are also moving at a satisfactory rate apparently, and although stocks of used cars are materially higher at present than at the beginning of the year they are in line with current retail demand.

One effect, however, of an increase in sales, if maintained during the next few weeks, will be to put off still farther new model introductions. It does not appear likely as a matter of fact, even now, that any number of new models will make their appearance before December. If sales drop off once more to less than normal levels for the period of the year all this would mean, would be a protracted shut-down for some plants for clean-up purposes.

Dodge Bros. reports shipments 20,491 cars and trucks including Plymouths for the month of August. Last week, ending Sept. 1, showed a decided pick-up in domestic retail deliveries with 2859 Dodge passenger cars sold, against 1903 the preceding week, the largest week in several months. At the same time sales of Dodge trucks virtually doubled with 2244 units compared with 1154 the preceding week.

DeSoto reports sales for same week up 7 per cent, while Plymouth sales for the week ending Sept. 1 exceeded the previous week by more than 25 per cent.

Packard is slowly getting into production with a double shift scheduled for next week.

Oldsmobile reports sales for the last ten days of August were the largest for any similar period this year.

New Packard Prices Range From $2,385

Prices on the new Packard models announced last week range from $2,385 for the 127-in. eight-cylinder sedan up to $4,950 for the 144-in. convertible sedan on the 12-cylinder chassis. Prices on typical sedan models follow:

Eight	
127-in., 5 p.	$2,385
134-in., 5 p.	2,585
139-in., 7 p.	2,755
Super Eight	
132-in., 5 p.	2,990
139-in , 5 p.	3,170
144-in., 5-7 p.	3,390
Twelve	
139-in., 5 p.	3,960
144-in., 5-7 p.	4,285

R. H. Grant Back

Richard H. Grant, vice-president of General Motors, returned to his desk this week after an illness of about two months.

ALB Authority Unchallenged By NLRB Houde Case Ruling

by Don Blanchard
Editor, Automotive Industries

In direct opposition to the policy enunciated in the settlement of last Spring's threatened strike against the automobile manufacturers which President Roosevelt said "lives up to the principles of collective bargaining," the National Labor Relations Board ruled late last week that representatives selected by the majority of workers should represent all the workers.

The decision was handed down by the board in a case involving the Houde Engineering Corp. of Buffalo, manufacturer of automobile parts, and sets a precedent not only for the industry's suppliers, but also for employers generally with the exception of the automobile manufacturers. So long as the automobile settlement remains in effect, proportional representation for the majority and minorities will rule in the car making plants. The Board took this position in its ruling apparently on the ground that the settlement was a collective agreement reached in accordance with 7a and that if the majority were disposed to accept proportional representation, the Board had no reason to

interfere. Of course, with the backing of the NLRB ruling, it will not be surprising if the unions seek to eliminate proportional representation from the automobile settlement when a favorable opportunity develops and, if they are successful, the car plants obviously would then no longer be exceptions to the general rule just established.

Specifically in regard to the automobile settlement, the Board said: "At the hearing, the company suggested . . . that the company might bargain collectively and enter into a collective agreement with a composite committee made up of representatives of the Union and the Association, in proportions corresponding to the votes cast in the election. This suggestion would have the merit of including both the majority and the minority representatives in the negotiations, and would on its face be just and democratic. And where, as in the automobile settlement, the parties agreed to such a plan, there could be no possible conflict with the statute, which clearly permits the majority to set up any fair plan of representation which they desire.

Auto Settlement OK'd

"But there was no such agreement in this case, and the plan suggested by the company, being opposed by the majority, would have hindered true collective bargaining. . . ."

No statement could be obtained from the Houde Company as to its reaction to the ruling, but whether or not it decides to challenge its legality, there is no doubt any attempt to apply it generally will throw the question into the courts with the probable consequence that the many legal and constitutional questions regarding Section 7a finally will be ruled upon judicially. In such court tests, employers, among other things, will be able to cite the interpretations of General Johnson and Donald Richberg that the statute means that employers must bargain collectively with the representatives freely selected by any group regardless of whether they represent a majority or minority.

The NLRB decision in favor of majority representation in the Houde case created considerable uncertainty as to the status of the Automobile Labor Board headed by Dr. Leo Wolman, perhaps because the reference to the automobile settlement quoted previously was not emphasized in the daily press. In this connection, it might be said that the ALB has complete jurisdiction over the automobile manufacturing industry, and has ruled for proportional representation for employees in that industry. Subsequent to the settlement, it was empowered by an order issued by General Johnson to hear and rule on cases concerning the automotive parts and equipment industry. This authority, however, was limited by requiring acceptance by both parties of the ALB authority.

Only a few cases involving parts makers have been heard by the ALB and these have dealt mainly with discrimination charges. Since the NLRB and its predecessor, the Wagner National Labor Board, have both favored majority rule rather than proportional representation of employees in a specific plant, the A. F. of L. and other labor organizations have been unwilling to accept jurisdiction of Dr. Wolman's board in representation disputes.

The status, therefore, is that the ALB has jurisdiction over automobile manufacturers while the NLRB to all practical purposes has jurisdiction over parts and equipment manufacturers. It is understood that some efforts are being made at present to clear up this anomalous situation but what, if anything, will come out of present conferences in Washington is in doubt.

Reverting to the Houde ruling, the NLRB said further that the employer's responsibilities under 7a did not end with receiving the representatives freely selected by the workers. He must use every reasonable effort to reach an agreement which customarily will have to do with wages, hours and basic working conditions, and will have a fixed duration. Although the board does not indicate that it refers to a signed agreement in this connection, the A. F. of L. has interpreted it to mean that. There is no doubt that any attempt to impose signed agreements on employers will meet with even more opposition than the majority representation ruling, not only because they lead to the closed shop, but also because they are one way affairs binding the employer but not the union, as the cotton textile strike is demonstrating.

L. B. Manning
New Cord Corp. President

The Houde ruling declared that the representatives of the A. F. of L. union, who had been elected by a majority of the workers in an election, should be recognized as the representatives of all of the workers. In the election, the union got 1105 votes and the plant association of employees 647 votes with about 400 not voting. The company's contention for proportional representation was denied.

Of course, the ruling works both ways. Where the company union polls the majority, its representatives will be recognized. In view of this fact, one effect of the ruling is expected to be renewed efforts to strengthen employee representation plans.

New Truck Registrations

July and Seven Months, 1934 and 1933, Compared

	July 1934	July 1933	7 Mos. 1934	7 Mos. 1933	Per cent increase 7 Mos., 1934, over 7 Mos., 1933	Per cent of total seven months. 1934	1933
Chevrolet	14,704	14,613	91,630	55,030	66.7	39.45	44.57
Ford	12,492	7,058	73,995	31,315	136.0	31.86	25.36
Dodge	4,224	2,582	26,219	7,917	231.8	11.29	6.41
I. H. C.	2,548	3,007	17,836	13,283	34.0	7.68	10.76
G. M. C.	951	757	5,430	3,564	52.3	2.34	2.89
Diamond T.	457	440	3,307	2,121	56.0	1.42	1.72
Reo	416	381	3,114	1,585	96.5	1.34	1.28
White	352	143	2,644	870	204.5	1.14	.70
Mack	202	217	1,224	851	43.8	.53	.69
Federal	182	171	1,153	675	71.0	.50	.55
Studebaker	156	198	938	1,154	—18.8	.40	.93
Brockway	147	107	765	490	56.0	.33	.40
Autocar	99	137	629	565	11.2	.27	.46
Stewart	67	74	515	341	51.0	.22	.28
Indiana	44	160	394	712	—44.8	.17	.58
Austin	17	91	389	600	—35.3	.17	.49
All Others	432	506	2,062	2,399	—14.0	.89	1.93
Total	37,490	30,642	232,244	123,472	88.0	100.00	100.00

— = Decrease.

Manning Named President by Cord Corp. Directors

L. B. Manning has been elected president of the Cord Corp. succeeding E. L. Cord, according to a recent announcement by the organization's directorate. Mr. Cord remains a member of the board and of the corporation's executive committee. The promotion of Mr. Manning has been expected for some time, inasmuch as he virtually has been in command of the Cord enterprises for the last two years.

Mr. Manning entered the automobile business in 1915 in Tacoma, Wash., as a retail automobile and truck tire salesman. In 1922 he went to Chicago and became associated with the brokerage firm of Seaverns & Co., and in 1923 entered the automobile manufacturing field with Mr. Cord, when they became associated with the Auburn company. It was Mr. Manning's interest in aviation which led the Cord group to enter the aviation manufacturing field in 1929 with the purchase of the Stinson Aircraft Corp.

W. H. Beal's election as vice-president and assistant to Mr. Manning was announced last week in *Automotive Industries.*

Giant Timken roller bearing designed for a cement mill where it will carry a load of more than one million pounds

Detroit Sales Lower

Wayne County (Detroit) new car registrations for August showed a decided drop with a total of 3599 against 5692 in July and 6117 in August last year. Commercial car sales on the other hand increased with 520 against 456 in July and 359 in August, 1933.

Court Approves W-O Canadian Assets Sale

Approval of the sale of the assets of Willys-Overland, Ltd., Toronto, by receivers under a plan by which the parent company received $25,000 in cash, retains patent and sales rights, and is relieved of obligation on a guarantee of $213,000 claim of the Canadian Bank of Commerce, was given by Judge George P. Hahn in the Federal Court at Toledo Thursday. Testimony was offered to show that creditors' committee representing 58 per cent or $3,600,000 of claims and the trustee for bondholders approved the sale. Counsel for the Snyder Tool & Engine Co., Detroit, objecting to the sale, declared elimination of Canadian company from Willys-Overland balance sheet would show the parent company hopelessly bankrupt and that the whole matter should be thrown into bankruptcy court as previously sought. Counsel for the creditors and receivers said there was nothing to indicate that the Canadian assets were carried in the balance sheet, as all subsidiary investments are lumped together.

Receiver D. R. Wilson said it would cost from $4,000 to $6,000 a month to carry the property if no sale were made.

New Passenger Car Registrations

	July, 1934	Per cent increase July, 1934, over July, 1933	Per cent change, July, 1934, over June, 1934	Seven Months 1934	Seven Months 1933	Per cent change, 7 mos., 1934 over 1933	Per cent of Total. First Seven Months 1934	Per cent of Total. First Seven Months 1933
Ford	63,126	64.8	— 1.7	358,240	170,297	110.5	29.27	19.62
Chevrolet	66,960	12.8	+ 3.7	335,606	289,918	16.9	27.42	33.39
Plymouth	38,244	19.8	+ 12.3	197,159	131,487	49.8	16.11	15.15
Dodge	10,021	—10.5	+ 8.6	59,425	45,044	32.1	4.86	5.19
Pontiac	8,613	—23.2	— 4.5	50,313	54,391	— 7.5	4.11	6.26
Oldsmobile	9,188	107.0	+None	43,517	22,206	96.0	3.56	2.56
Buick	7,946	56.7	— 4.3	38,914	30,341	28.2	3.18	3.49
Studebaker	4,745	15.1	— 9.2	27,636	21,429	29.0	2.26	2.47
Terraplane	4,202	—10.3	— 9.8	26,867	20,271	32.4	2.20	2.33
Chrysler	3,256	—20.6	+ .1	16,308	16,738	— 2.6	1.33	1.93
Hudson	1,928	482.0	— 3.4	12,906	2,110	512.0	1.05	.24
Nash	1,216	9.0	— 9.6	9,629	6,869	40.0	.79	.79
Graham	1,532	33.8	+ 18.7	8,461	6,275	35.0	.69	.72
De Soto	1,372	—45.0	+ 19.8	7,005	11,881	—41.1	.57	1.37
LaFayette	1,409	....	+ 2.8	4,196	.....	....	.34	....
Willys	938	—35.1	+ 21.5	4,121	10,356	—60.2	.34	1.19
Packard	840	4.2	+ 44.5	3,645	5,555	—34.3	.30	.64
Hupmobile	692	— .3	+ 3.5	3,397	4,349	—21.8	.28	.50
La Salle	593	34.0	— 22.2	3,352	2,290	46.2	.27	.26
Cadillac	400	4.5	— 20.0	3,335	2,645	26.0	.27	.30
Auburn	602	9.2	+ 26.1	2,901	3,579	—19.0	.24	.41
Reo	467	17.8	+None	2,364	1,982	19.2	.19	.23
Lincoln	158	—26.5	— 8.6	1,217	1,397	—12.8	.10	.16
Pierce-Arrow	220	— 4.4	+ 14.0	1,154	1,130	2.1	.09	.13
Continental	19	—94.2	— 17.4	911	1,081	—15.7	.07	.12
Austin	35	9.2	— 39.7	776	2,518	—69.2	.06	.29
Franklin	12	—92.2	— 73.3	336	828	—59.5	.03	.10
Miscellaneous	26	—65.8	14.4	190	1,214	—84.3	.02	.16
Total	228,760	23.2	2.3	1,223,881	868,181	41.0	100.00	100.00
Chrysler Corp.	52,893	6.3	11.0	279,897	205,123	36.5	22.87	23.64
Ford and Lincoln	63,284	64.2	— 1.9	359,457	171,679	109.5	29.37	19.78
General Motors	93,700	15.7	1.6	475,037	401,686	18.2	38.81	46.26
All Others	18,883	14.8	— 1.5	109,490	89,693	22.3	8.95	10.32

— = Decrease.

AFL's "Enormous Profits" Charge Fails To Halt Extension Of Automobile Code

Overriding the fulminations of the American Federation of Labor, the President on Sept. 1 acted on the application of the automobile manufacturers and extended their code without change for 60 days, which makes the expiration date Nov. 3, 1934, unless the President declares the emergency ended at an earlier date.

Although the details of the A. F. of L. demands have not been revealed, it is understood that its representatives, in addition to urging the deletion of the merit clause, contended for a 36-hr. maximum week without averaging and for time and a half for hours in excess of the maximum. This contrasts with a maximum of 35 hr. per week averaged over the year and a top of six days or 48 hr. in any one week as provided in the code. It is also reported that union leaders desired to shear the Automobile Labor Board of some of its powers, the intent apparently being to have these powers transferred to the National Labor Relations Board in Washington.

The industry's position was that it was willing to go along for a further experimental period provided there was no vital change in either the code or the President's settlement. It may be stated unequivocally, moreover, that the manufacturers will wage a last-ditch fight against any future attempt to eliminate the merit clause. Although the significance of this clause has been played down by NRA, the industry feels that its elimination would be interpreted by labor leaders as the withdrawal of a privilege which, as a matter of fact, is a basic legal right.

When it became clear that the code would be extended without change, a vigorous blast was issued by the labor leaders protesting against the renewal. The statement said in part:

"Through the past year the manufacturers have made enormous profits from which they have declared extra dividends through a combination of a meaningless code and a great demand for automobiles arising from the New Deal applied to the rest of the country. . . . The National Council of United Automobile Workers . . . have said to the Administration that the automobile workers have not benefited by the code and will not unless changes along the lines suggested are adopted. . . . We have only urged a reasonable program. The code should give some protection to workers, should provide an extension of employment, and at the same time should not place upon the industry any more than it should carry in order to contribute to a new deal from which it has so profited."

A good many automobile manufacturers would like to know who got the enormous profits referred to in the foregoing. General Motors reported profits of $69,000,000 for the first half against $48,000,000 in the same period last year, but its sales increased 63 per cent. As a result, the percentage of its net sales salvaged as earnings dropped from 15.4 in the first six months of 1933 to 13.4 this year despite the fact that increased sales ordinarily spell larger profit margins. For the same periods, Chrysler shows more than 100 per cent increase in sales, but its net profits were less than double. For 12 other vehicle companies, a compilation shows that they sustained a combined loss of roughly $8,000,000 in the first half of this year against a loss of $7,300,000 in the same period last year. The record would seem to indicate that whatever benefits the New Deal has brought to the automobile manufacturers have been shared by somebody besides the stockholders. Certainly with a numerical majority of the vehicle manufacturers in the red, or very close to it, the wisdom of further complicating their financial problems by burdening them with increased labor costs at a time when compensating price increases are impractical may be questioned not merely by stockholders but also by automotive workers whose jobs may be jeopardized by continued unprofitable operations of their employers.

As to whether the position of labor has been improved, the indexes of automotive employment and payrolls provide abundant direct evidence that it has.

Hudson Leaves Reo To Join Studebaker Corp.

Richard Hudson, for 12 years manager of the export sales division of Reo, has resigned to assume managership of the commercial transportation division of Studebaker Export Corp., the latter organization announced this week. Mr. Hudson assumed his new duties immediately.

When Reo entered the export business Mr. Hudson was assigned to organize the division and has been manager of it ever since its inception. Mr. Hudson began his career in the automotive industry 15 years ago in the production division of Reo.

Sloan Returns from Europe

Opposition to further code regulations which tend to decrease working hours below their present limits was expressed by Alfred P. Sloan, Jr., GM president, when he arrived in this country last week from Europe abroad the Europa. At the same time Mr. Sloan announced his approval of the basic principles of the newly launched Liberty League.

Discussing further cuts in working hours and corresponding pay increases, Mr. Sloan said: "Despite the belief of advocates of shorter hours and pay rises, it tends to reduce the total amount of employment and it forces a rise in prices which always go up faster than wages. Of course, I believe in more leisure for workers, but we should get it by reduced costs and increased efficiency, not by government edict. We should earn our leisure."

GM Proposes Changes In Management Corp.

Stockholders' Meeting Called Sept. 27 to Consider Amendments

Proposed amendments to the General Motors Management Corp., the profit-sharing plan for executives of GM, will be voted upon by General Motors stockholders at a meeting called by the corporation for Sept. 27, according to an announcement by the organization in last week's bulletin of the New York Stock Exchange. So far no other announcement relative to the proposed meeting has been issued.

The Management Corporation was formed in 1930 to take over and extend the function of the Managers' Securities Co. formed in 1923 to enable executives of GM to participate in earnings of the parent corporation. Under the terms of the contract between GM and the management organization, GM agreed to pay, for a term of seven years (terminating in 1936), 5 per cent of its net earnings after allowing 7 per cent on the capital employed to the management corporation, and in addition to use another 5 per cent of its net earnings to purchase Class A stock of the management corporation at its book value.

In 1931 GM paid the subsidiary organization $3,965,000, representing the full 10 per cent, and in that year 1481 members of the GM executive staff participated. No earnings accrued to the management division in 1932, but last year the parent organization paid the subsidiary company $1,368,000 accrued from GM for the benefit of 1234 executives.

At its inception the management company financed the purchase of 1,375,000 shares of GM common at $40 per share through the issuance of $50,000,000 of seven-year 6 per cent serial bonds and the sale of 50,000 common shares at $100 per share. On Dec. 26, 1933, GM advanced the subsidiary $1,000,000 in anticipation of the amount due March 10 of this year. This money was used to retire $975,000 of the serial bonds outstanding. An additional $375,000 of the bonds were retired March 15 of this year.

Bob McCurdy, 20-year-old farm boy from near Oskaloosa, Iowa, who won a de luxe Plymouth sedan in the Chrysler Motors-National 4-H Club story contest. Here he is receiving his prize from Barney Oldfield on the Chrysler Motors track at the World's Fair.

Hudson Local Protests Recent Company Election

A protest has been filed with the Automobile Labor Board by the newly organized Associated Automobile Workers of America against a recent election held by the Hudson Industrial Association to name 40 nominees for representative positions in future collective bargaining conferences with the Hudson Motor Car Co.

Arthur Greer, chairman of the AAWA, termed the election "a farce" when he appeared before the ALB and turned the issue into "company union vs. outside union." Greer charged Hudson had violated Section 7a by having a company representative present at the election. The ALB took the matter under advisement and a decision was expected this week.

Proposed Credit Rules Will Affect Car Makers

Additional regulations covering credit terms extended by wholesalers of automotive merchandise have been submitted to NRA by the code authority for the Wholesale Automotive Trade. The code authority also has submitted a plan of open price filing as required by NRA where codes set up uniform credit terms. This plan will shoulder District Administrative Agencies of the jobber code with what may prove to be a mammoth task of record-keeping and price reporting.

The new regulations, if approved, will apply to wholesaling of automotive merchandise no matter by whom performed —which means that they apply to wholesaling of parts, accessories and equipment by car factories, car distributors and parts makers.

Any objections to the proposed regulations must be submitted to Deputy Administrator Jo G. Roberts before Sept. 12.

NLRB Applies Houde Ruling to Guide Case

The National Labor Relations Board on September 5 followed up its decision in the Houde Engineering Corporation with the application of the majority rule principle in the case of the Guide Lamp Corporation of Anderson, Indiana.

The Board ruled that the Guide Lamp Corporation must recognize the Metal Polishers International Union, Local No. 52, as the exclusive bargaining agency of the employees in certain departments of the company.

The union won an election conducted in those departments by 329 votes to 286 for the Guide Employees Association.

The Guide Company which is a G.M. subsidiary is given 10 days to notify the board that it will recognize the union representatives as the exclusive bargaining agency of its employees eligible to participate in the election and that when requested by the union it will endeavor in good faith to reach a collective agreement. Failing such notification, the board will refer the case to NRA and to the Federal enforcement agencies.

Fisher Lumber Order Stirs Up A Tempest

GM Officials Refuse Comment on Reported Offer Under Code Price

"The hardest blow which has yet been struck against fixed prices in the hardwood industry came this week when the Fisher Lumber Corporation (a General Motors subsidiary), the largest buyer of hardwood in the world, and about the best friend the industry has, offered an order for a quantity of 4-4 mixed oak, estimated at anywhere from 10,000,000 to 20,000,000 feet, at several dollars below code prices," W. D. Jemison, editor of the *Memphis Lumberman* is quoted as saying last week.

"It is understood that all of the order offered has been accepted by hardwood firms in the south which usually handle this business," Mr. Jemison continued, "and in only two or three instances was any of the business refused."

At the Hardwood Manufacturers' Institute, Memphis papers say, the report stirred up the greatest storm yet to break in the industry since the prices were first established. It was asserted that the Institute admitted that several companies, regarded as favoring fixed prices, had accepted parts of the Fisher order. It was also indicated that considerable apprehension was felt as to the possible effect of so large an order not only on the lumber industry, but on the whole NRA program.

General Motors officials in Detroit who were approached by *Automotive Industries*, refused all comment on the report.

NRA has promised the lumber code authority that prompt legal action would be taken in connection with the alleged non-compliance with the lumber code on the part of the sellers.

Conferences in Washington were held between representatives of the lumber code authority and of the NRA. Conferences in Detroit were held between NRA and General Motors officials while those in Memphis were held between representatives of the lumber code authority and Fisher Body officials.

New Agency for Pontiac

Pontiac is transferring its advertising account to MacManus, John and Adams, recently formed agency with offices in the Fisher Building in Detroit.

While official confirmation is lacking, it is reported on good authority that one other G.M. car division—said to be Oldsmobile—will also change agencies in the near future. This report states that the account will be handled by a new agency headed by a former advertising executive of General Motors.

Hanch Resigns Job With NAFC

Internal Dissensions Hinted; Continues As Counsel and Advisor

C. C. Hanch, secretary and general manager of the National Association of Finance Companies since 1925, has resigned effective Sept. 1. Until the directors name his successor, the executive committee has appointed Milan V. Ayres, the association's analyst, as acting secretary.

Mr. Hanch will devote himself to the work of automotive counsel and patent advisor, the activity in which he was engaged prior to coming with the association and which he has never entirely abandoned. He has been active in the automobile field most of his business life, having held official positions with Marmon, Studebaker, Maxwell and Lexington. For many years he was vice-president of the National Automobile Chamber of Commerce in charge of its patent division which he created. During the war he was Chief of the Automotive Products Section of the War Industries Board.

The announcement of Mr. Hanch's resignation occasioned expressions of regret from the association staff and from the membership. Victor L. Brown, president of the association wrote, "You have done such a fine job for the finance industry, and you have been so largely instrumental in elevating the tone and character of the business that I regret exceedingly your decision to resign from the office which you have so long filled with singular devotion and ability."

Although no reasons for Mr. Hanch's resignation have been revealed, it is inferred from a letter regretting his decision written by Arthur W. Newton, vice-president of the First National Bank of Chicago, that dissensions among the members were a factor. Apparently in connection with his resignation Mr. Hanch wrote the membership calling their attention to the effects discord might have, for Mr. Newton says:

"Your admonition to the members is very timely and well taken. It will be a calamity to the finance business if, as a result of their dissensions, they are left without those various forms of protection with which you have provided them for nearly all of the past ten years. This is particularly true at the present time when the tendency of governmental interference, both state and federal, is stronger at this time perhaps than it has ever been."

C. C. Hanch

Fisher Body Scholarship Winners

Each of these six boys have been awarded a scholarship valued at $5000 for building the most perfect miniature models of a Napoleonic coach in the Fisher Craftsman's Guild competition. From left to right they are: Bartholomew Mandel, Detroit; Robert H. Hellman, Indianapolis; Franklin S. Atwater, New Britain; Frank F. Hines, Blacksville, W. Va.; W. A. Fisher, president of the Guild; R. S. McLaughlin, Oshawa, Ont., president of the Canadian section of the Guild; J. Ross Farquharson, Vancouver, and Harold E. Rasmussen, Regina, Sask.

Studebaker Corp.

The Studebaker receivers' report for the quarter ended June 30 shows net sales totaled $12,163,323 against $9,522,885 for the same three months of 1933. After all charges net earnings were $32,306 against a net loss of $187,493 for the corresponding period of last year. The statement for the first six months of the current year shows net sales of $22,817,659 with a net loss of $297,327 after all deductions, including a $47,878 depreciation charge but not including depreciation of manufacturing plants and property.

Current assets of the company for the first half of this year totaled $9,190,969, against $9,589,169 for the same time last year. Current assets include, cash, $2,487,483; sight drafts, $1,193,329; accounts and notes receivable, $679,749; inventories, $4,830,408. Liabilities for the first half of this year showed a decrease of approximately $1,000,000 from the total at the close of business Dec. 31, 1933. Current liabilities as of June 30 included accounts payable, $1,803,018; accrued taxes, etc., $1,057,220; advances against export drafts, $186,697; dealer deposits, $213,420.

The working capital of the corporation as of June 30 showed a slight increase over Dec. 31, 1933; the figures are $5,930,614 for June 30 against $5,757,210 for Dec. 31, 1933.

Two Electroplating Meetings Sept. 26

Two conferences on electroplating will be held in the Hotel Pennsylvania, New York, Sept. 26. These conferences are under the auspices of the American Electroplaters' Society and the American Society for Testing Metals and come the day prior to the meeting of the American Electrochemical Society.

The morning session will be devoted to a discussion of proposed specifications for plating of nickel, chromium, zinc and cadmium on steel. At the afternoon meeting there will be discussions on the proposed program for exposure tests of plating on non-ferrous metals including copper, brass, zinc and die castings.

AMA Endorses State Department's Move For Belgium Reciprocal Trade Compact

Moving ahead with its plans for reciprocal trade agreements, endorsed by the Automobile Manufacturers Association, Acting Secretary of State R. Walton Moore has announced his intention to negotiate such an agreement with Belgium. Automotive interests see in these trade agreements opportunities to build up export markets, and in the case of Belgium are hoping for a further increase in shipments to that country. Automobiles from the United States are an important item in Belgian imports.

In 1933 Belgium took 9113 American automobiles, valued at $4,210,231, compared with 16,913, valued at $12,655,913 in 1929. American motor trucks, buses and chassis to the number of 3179, valued at $984,359, were shipped to Belgium last year, while in 1929, shipments totaled 12,970, valued at $5,144,631.

Other exports of American automotive items to Belgium were:

	1933	1929
Wheel tractors and parts	$ 21,573	$ 200,580
Automobile parts for assembly	585,379	1,032,751
Automobile parts for replacement	1,370,647	2,730,988
Automobile tire casings and inner tubes of rubber	351,652	1,710,632

This marks the first entry of trade negotiations into the European field. It is planned to negotiate treaties with other European countries in the near future. Plans are also pending to negotiate treaties with South American countries, among the first on the list being Brazil and Colombia.

The Committee for Reciprocity Information has anounced that all information and views in writing and all applications for supplemental oral presentation of views regarding the proposed Belgian agreement shall be submitted to the committee, in care of the United States Tariff Commission, not later than noon, Oct. 22. Oral presentation of views by persons whose applications have been approved will be heard Oct. 29.

GM Issues Statement on Industrial Relations

General Motors has sent to all divisions a statement of the corporation's basic policies governing its relations with factory employees. The statement is signed by Alfred P. Sloan and was approved by the executive committee. Because of the broad automotive interest in the policies which will govern the corporation's relations with its employees, and also because the conclusions, which presumably were reached by its industrial relations and legal experts, may prove helpful to other manufacturers, *Automotive Industries* will print the statement in full next week rather than to try to summarize it here.

New NRA Rule Requires Posting of All Orders

New NRA regulations have been issued requiring employers to post orders, interpretations, explanations or statements issued by the President or the Administrator. These are to be posted in connection with code provisions and are additional to regulations previously issued, requiring posting of labor provisions of codes.

NEMA, Automotive Credit Join Service Facilities

Arrangements have been completed, according to an M.E.M.A. statement, to combine the facilities of the M.E.M.A. credit service and the Automotive Credit Service, Inc. under a unified plan to eliminate duplication, provide additional service benefits and strengthen the respective credit discussions of the two groups.

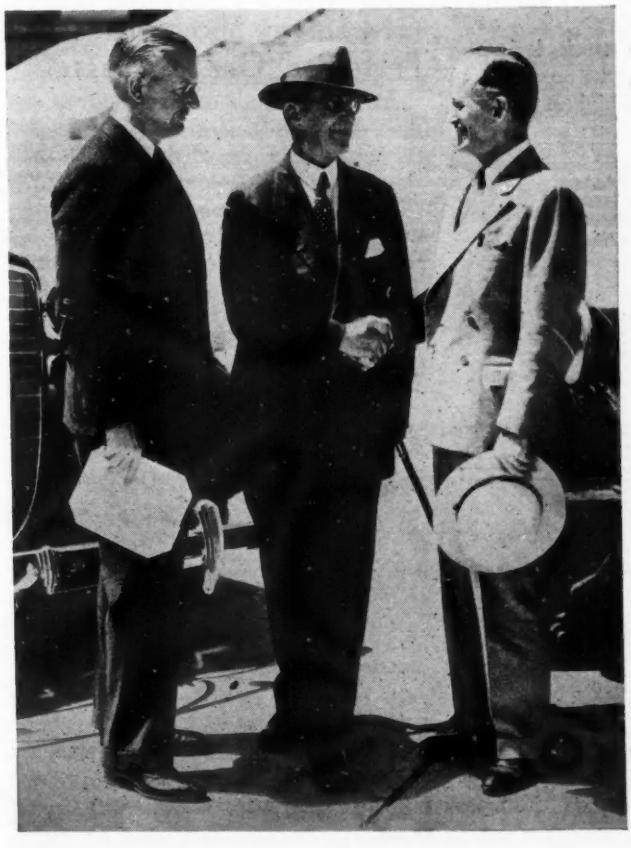
There has been a tendency in the M.E.M.A. credit service toward the aftermarket activities, while the Automotive Credit Service, Inc. has been expanding along lines of intensive coverage of the car and truck manufacturers, and concerns in kindred lines, according to the M.E.M.A. announcement. The new arrangement makes available to members of each organization complete credit information coverage in both fields.

No Finance Co. Code

"No code for finance companies" is the estimate made by the National Association of Finance Companies of the probable results of the negotiations it has been conducting with NRA. In its latest bulletin, the association says a "final draft of code," prepared by NRA and revised twice by NRA, has been sent to the members. Since then, more code redrafting has been taking place and the association asserts that apparently the final outcome will be no code.

Army Buys 2000 Vehicles from Chevrolet and Fargo

Chevrolet and Fargo Motor Co. have received contracts from the War Department for 2,000 passenger cars and trucks to cost more than $1,000,000 according to announcements from the department. The Chevrolet company received contracts for 1,531 trucks at $910,407.87; the Fargo organization's contracts call for 492 trucks and passenger cars costing $256,055.94.



Courtney Johnson (left), Nash general sales manager, presents Dr. Edgar O. Nash, no relative of the manufacturer's, with the one millionth Nash. Dr. Nash is in the center with Mayor Begole of Denver on the right

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for Automotive Industries

There was a continued expansion in wholesale and retail trade last week, although there was a further decline in general industrial activity. Some industries were largely dependent on government-subsidized business for their orders. Steel production reached the lowest point since March, 1933. Bituminous coal production continued to decline, although the rate of output during the entire month of August was almost 15 per cent above that a year ago. There was a slight reduction in the amount of bank clearings, and the number of commercial failures increased moderately.

Car Loadings Gain

Railway freight loadings during the week ended Aug. 25 amounted to 605,516 cars, which marks an increase of 4,952 cars above those during the preceding week, a decrease of 31,994 cars below those a year ago, and an increase of 67,749 cars above those two years ago.

Exports, Imports Decline

There was a greater than seasonal decline in foreign trade of the United States during July. Exports totaled $161,787,000, as compared with $170,571,000 during June. Imports were valued at $127,324,000, as compared with $136,082,000 during the preceding month.

Current Consumption Steady

Production of electricity by the electric light and power industry in the United States during the week ended Aug. 25 was 1.1 per cent above that in the corresponding period last year. The current level of production is below that during the preceding week.

Lumber Shipments Heavy

With the exception of the two weeks preceding, lumber shipments during the week ended Aug. 25 were the heaviest since last April. Orders received, however, were somewhat below the levels in the four weeks preceding. Although production was below the rate during the two weeks preceding, it was the largest since last May.

Crude Output Drops

Average daily crude oil production during the week ended Aug. 25 amounted to 2,464,700 barrels, as against 2,518,700 barrels for the preceding week and 2,756,400 barrels for a year ago.

Fisher's Index

Professor Fisher's index of wholesale commodity prices for the week ended Sept. 1 stood at 79.7, as against 78.5 for the week before and 77.8 for two weeks before. The current figure is the highest since 1930.

Federal Reserve Statement

The consolidated statement of the Federal Reserve banks for the week ended Aug. 29 showed an increase of $1,000,000 in holdings of discounted bills. Holdings of bills bought in the open market and of government securities remained unchanged.

To Extend Ford Plants In Australia, S. Africa

Increased business for the Ford Motor Company in Australia and South Africa have made necessary plant extensions in both countries, according to W. R. Campbell, president of the Ford Motor Company of Canada, Limited. The Australian and South African companies are affiliated with the Canadian organization. Workers in the Ford plant at Geelong, Australia, have been increased from 300 men six months ago to 1,000 to date. Ford sales in Australia during July totalled 900 cars, the best month in fonr years, it is stated. The body manufacturing plant at Geelong is being extended and in addition dry kilns erected for the treating of wood used in automobile bodies. In the last three months, automobile registrations in Australia have shown an increase of 30 per cent.

During the past six months, sales in South Africa have doubled those of any previous six months period, and two extensions to the Port Elizabeth plant have been authorized since December. These will increase the floor space by over 30,000 square feet.

Auto-Lite Gets Chrysler Equipment Contract for '35

Electric Auto-Lite Co. and two of its controlled companies have been awarded contracts for the 1935 models of Chrysler, DeSoto, Plymouth and Dodge passenger cars and trucks it was announced today by Royce G. Martin, president.

Total Chrysler production for the coming year is estimated at 600,000 units and Toledo plants of Auto-Lite and Motometer are scheduled to employ 3,500 workers. "This contract brings to Auto-Lite one of the largest pieces of business in the last 20 years and fits in with trade expansion program undertaken earlier in the year," said Martin. He referred to acquisition of Owen-Dyneto Corp., Syracuse, N. Y., Motometer in Toledo and Corcoran-Brown Lamp Co., Cincinnati. Auto-Lite will furnish all Chrysler ignition, Motometer will furnish panels, instruments and tail lamps, and large percentage of scuff plates, hub caps and horns. Corcoran-Brown will supply large percentage of lamps, including all Plymouth general equipment lamps.

GM Survey Shows Buick Preferred Car in Class

A current motor car style survey conducted by the General Motors Customer Research Staff revealed Buick is considered the "best looking" car in its price class. The survey was conducted among thousands of motorists throughout the country on the basis of individual taste in motor car design. Buick received 23.7 per cent of all votes cast, more than three times the average of the other 10 cars in the price class covered.

Automotive Executives On Safety Congress Program

Automotive executives will occupy prominent places on the program of the National Safety Council when that organization opens its 23d annual Safety Congress and Exposition Oct. 1 in Cleveland. On the opening day of the congress J. D. Lyle, personnel director of Fisher Body, will discuss "Trend of Accidents in the Power Press Section." On Thursday, Oct. 4, G. F. Oliver, factory manager of the Murray Manufacturing Co., will talk on "Heavy and Light Press Operations."

Automotive Exports To Argentina Up 100%

Parts and Accessories Share in Increased Business, Report Shows

The improved economic position of Argentina during the current year has not only resulted in 100 per cent increase in purchases abroad of motor vehicles, but also of automotive parts and accessories, according to a report to the Commerce Department from its Buenos Aires office. During the first five months of 1934, U. S. exports of such items to the Argentine market were valued at $1,553,000, as compared with $554,000 in the corresponding period of 1933.

Total imports for the first seven months of this year amounted to 10,885 units against 5,150 units for the same period of 1933, an approximate increase of 111 per cent. Of this total American makes accounted for 89.5 per cent of the total. In the January-July period American-made passenger cars imported into Argentina totaled 6,772 units, a gain of 93.4 per cent over the corresponding period of last year. American trucks in this same period of this year totaled 3,639, a gain of more than 228 per cent over the same period of 1933.

At the present time, the report points out, the exchange situation as related to automotive parts and accessories is very uncertain. Prior to the first of June, importers of such products had been very fortunate in being able to obtain exchange at official rates to cover most of their importations. However, since the middle of June no "previous" permits have been issued for automotive parts, etc., and the Ministry of Finance has not given any indication along this line for the future.

Orders are being held up because of the fact that dealers do not wish to go into the free market until it is definitely known that they will be forced to. One source in close touch with the trade, the report states, predicted that before the end of the year there would be a notable shortage of automotive parts, etc., if some indication were not forthcoming from the Exchange Control Office as to its position on automotive part imports before that time.

There is only a limited demand for imported garage equipment in Argentina, the report points out, a large number of items in this class being locally manufactured. In the case of paint spray equipment, however, there is a good demand, with two well-known American brands leading in sales.

Special Rail and Hotel Rates for Service Show

Railroad passenger associations both in the United States and Canada and the Cleveland hotels have recognized the national automotive organizations whose conventions will be held in Cleveland coincidental with the Automotive Industries Show, Nov. 19 to 23, and will grant reduced rates to all those planning to attend the show and conventions.

The railroads will make a special rate of one and one-third fares for the round trip, just as was done last year when the show was held in Chicago during the World's Fair. Arrangements also have been made with practically all hotels in Cleveland for reduced rates established in advance of the arrival of the delegates.

William H. French

William H. French, secretary and treasurer of the Richmond Hammered Piston Ring Co., Souderton, Pa., died last Saturday at his home following a heart attack. Mr. French, who was 55 years of age, had been associated with the Richmond organization for more than 30 years. In addition to his widow he is survived by a son, William H. French, Jr., and a daughter, Mrs. Esther French Fisher.

Copper Used in New High Compression Head Design

It has been learned on reliable authority that Federal Mogul Corp. is to announce shortly completion of research and development work in connection with a cylinder head design involving the use of copper. The new head, it is reported, will permit the use of higher compression ratios than with materials now used for cylinder heads without the use of special anti-knock fuels.

The development is particularly interesting in view of the present trend toward higher compression ratios brought about by the desire for improved fuel economy. It is reported that the new head will offer material savings in fuel consumption in addition to obvious increases in specific power output. The development work, it is understood, has been carried on by Federal Mogul at the Battelle Memorial Institute over a considerable period of time and represents an entirely new activity for that corporation.

New Chrysler Film

Harry Morey, veteran of many Broadway and screen successes is starring in the new sound picture "Safety With A Thrill" which is being filmed for the Chrysler Corporation by Wilding Picture Productions, Inc.

APEM Supplements OK Momentarily Expected

Approval of five of the 14 APEM supplements, now in the hands of NRA, is expected at any time now, with final action on the remaining nine due within the next 30 days.

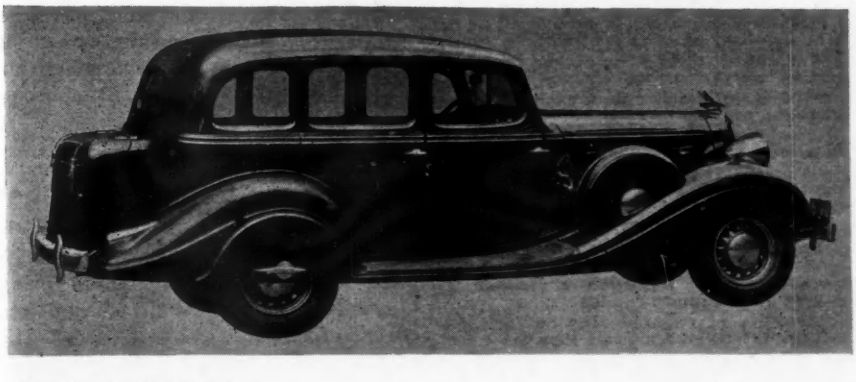
Chinese Has Special Car To Visit Ancestral Tomb

If the stipulation in the automobile dealers' code that a demonstrating car must have traveled a minimum of 3500 miles before it can be sold as a used car applied to automobiles in the hands of individuals there is one car, a Packard, which could not be sold as a used car for 159 years.

This car is owned by a wealthy merchant in China. In the two years since it was purchased it has been run only a total of 43 miles. That's less than every car is operated for testing before being shipped from the Packard factory.

The Chinese merchant who owns this particular Packard reserves it for an annual pilgrimage of 10 miles from his home to the temple containing the tombs of his ancestors. To pay the highest honor to his deceased parents he uses the car for no other purpose.

One of the New Hudson Trunk Models



Detroit Basing Point Decision Is Awaited

Automotive Buyers Hope for Favorable Action by Steel Code Authority

Automotive buyers of steel are eagerly awaiting what decision the Code Authority of the Steel Industry will reach with reference to a petition pending before it to make Detroit a basing point for cold rolled strip and merchant and cold finished bars. Quoting of delivered prices in the Detroit area on merchant and cold finished bars, common and cold rolled sheets, and hot rolled strip has been sanctioned for several years.

Elevating Detroit to the status of a basing point for the descriptions of steel named is a plan that meets with strenuous opposition from several quarters, all of the opposition, however, being based on the presumption that this petition, filed as it has been by one of the smaller producers, is a drive for lower prices inspired by pressure on the part of automotive consumers.

Some of the steel rollers on the banks of the Allegheny and Monongahela still cannot forgive the automobile industry for the building up of Detroit, instead of Pittsburgh, and argue that it is only fair that they should pay freight on their steel from Pittsburgh, though in many cases, because of the impressive increase in the capacity of Detroit district mills, it has become what is frequently referred to as "phantom freight." Nor are some of the Michigan steel producers, with heavy investments in relatively new plants, overjoyed at the prospects of losing what advantages they have under the prevailing marketing set-up, which to some extent is predicated on the needs of an amortizing margin to care for the heavy outlays for equipment that the birth of the Michigan steel industry entailed.

With the Ford Motor Co. actively pushing to completion its new plant for the cold rolling of wide strip, it is only natural that there should be considerable pressure on price from other automotive users. With so many angles to the problem, the Code Authority of the Steel Industry has a hard nut to crack in the petition for making Detroit a basing point.

Pig Iron—Third quarter prices have been generally reaffirmed for fourth quarter. Very little activity is noted so far in covering needs for the year's final period.

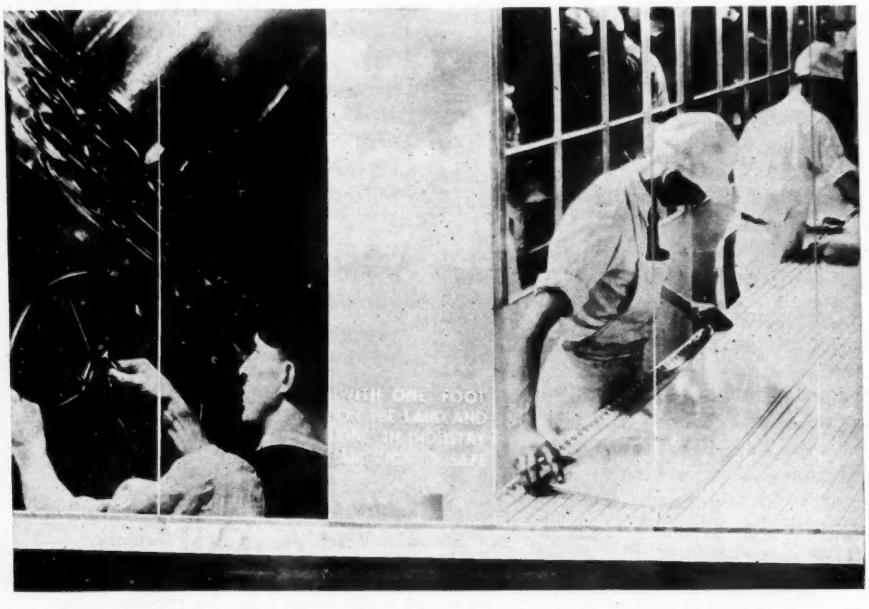
Aluminum—Quiet and unchanged.

Copper—Shortly before the Labor holiday, demand for "Blue Eagle" copper turned more active while tired, speculative holders of non-Blue Eagle metal disposed of as much of their holdings as they could under the label of "Standard" copper, a grade calling for a much lower purity than electrolytic. The "Blue Eagle" price remains at 9c, delivered Connecticut. There is much talk of the possibility of an early international conference to curtail world output.

Tin—Spot Straits tin opened slightly firmer at 52c on Tuesday, last week's close having been 51.55c.

Lead—Quiet and unchanged.

Zinc—Easier.



These 18 quotations of Henry Ford's, illustrative of his personal industrial, economic and social creed, form an important phase of the decorative scheme and part of the 600-foot photographic mural which adorns the central rotunda of the Ford Building at A Century of Progress

"High wages and best materials—the only road to low prices."

"Never yet has enough of any good thing been produced for use."

"The auto made roads and roads made commerce and civilization."

"If you stabilize anything, it is likely to be the wrong thing."

"Progress comes from prosperity built by work—done in peace."

"It is not good business unless both buyer and seller profit by it."

"With one foot on the land, and one in industry, America is safe."

"Industry is mind using nature to make human life more free."

"One third of A Century of Progress produced the new Ford V-8."

"Overproduction is a money cry, not a human cry; produce evermore."

"Individualism is what makes cooperation worth having."

"The farm and the shop each needs what the other produces."

"The recovery we need is of our American spirit of independence."

"Wages for work. Profit to make more efficient value for users."

"If we had more justice, there would be less need for charity."

"A cheaply made product is too expensive to be priced cheaply."

"Industry does not support man—it is man that supports industry."

"Growing of food, making of tools, transportation—three basic jobs."

Graham-Paige Appoints Glennie to New York

Appointment of Walter Glennie, former San Francisco district manager, as New York manager of the Graham-Paige Motors Corp., and subsequent West Coast personnel changes made necessary by Mr. Glennie's appointment have been announced by Robert C. Graham, executive vice-president.

Del Larson, former Seattle district manager for Graham, has been transferred to the position of San Francisco district manager, succeeding Mr. Glennie. Irwin Broze, former San Francisco field sales representative, has been promoted to the position of Seattle district manager, succeeding Mr. Larson. Roy O. Hague, former retail sales manager for Herbert D. Bell, San Francisco Graham distributor, has been appointed San Francisco district sales representative, succeeding Mr. Broze. George R. Morris, former general sales manager of the Continental Motor Co., has been appointed field sales representative attached to the San Francisco district office, with headquarters in Los Angeles.

Austin Resumes Operations

Operations have been resumed at the Butler, Pa., plant of the Austin Co., according to recent reports. It is stated that permission has been granted by the Court to build sufficient cars to meet present demands, and that necessary capital to carry on the work has been secured from deposits on the cars to be turned out through a corporation controlled by several leading distributors of the cars.

Rolls Royce Changes Name

According to current reports Rolls Royce of America, Inc. has changed its name to the Springfield Manufacturing Corp. It is understood the change was effective Aug. 29.

Peter W. Fassler, pioneer in resistance welding work, who has organized his own company for consulting work in electric welding

Passenger Car Production by Wholesale Price Classes
(U. S. and Canada)
Seven Months 1934 and 1933 Compared

	1934	1933	Per cent change	Per cent of Total 1934	Per cent of Total 1933
$500 and under	1,098,589	863,601	+27.1	64.62	81.10
$501-$750	515,099	152,900	+237.5	30.30	14.36
$751-$1,000	51,924	22,435	+132.0	3.05	2.11
$1,001-$1,500	22,145	13,259	+67.0	1.30	1.25
$1,501-$2,000	5,772	6,274	—8.0	.34	.59
$2,001-$3,000	4,943	5,194	—4.9	.30	.48
$3,001 and over	1,591	1,216	+31.0	.09	.11
Total	1,700,063	1,064,879	+59.8	100.00	100.00

Truck Production by Capacities
(U. S. and Canada)
Seven Months 1934 and 1933 Compared

	1934	1933	Per cent change	Per cent of Total 1934	Per cent of Total 1933
1½ tons and less	346,154	185,123	+87.0	92.6	92.8
2-3 tons	23,341	11,789	+97.5	6.2	5.9
3½ tons and over	3,286	1,756	+87.2	0.9	0.9
Special and buses	1,254	726	+73.0	0.3	0.4
Total	374,035	199,394	+87.5	100.0	100.0

Borg-Warner Buys Vapor Stove Co.

Howard E. Blood, vice-president Borg-Warner Corporation and president of its subsidiary, Norge Corporation, announces the acquisition of the Detroit Vapor Stove Company. The Detroit Vapor Stove Company will operate strictly as an independent Borg-Warner subsidiary.

Verville Assigned Post In Commerce Department

Appointment of Alfred V. Verville, airplane designer and former manufacturer, as chief of the Manufacturing Inspection Service of the Bureau of Air Commerce, Department of Commerce, was announced today by Col. J. Carroll Cone, assistant director in charge of air regulation.

Mr. Verville will supervise the examination of engineering plans for new types of airplanes, and inspection of completed planes which are submitted to the department for approval as to airworthiness, and subsequent licensing for use in air commerce. He succeeds John H. Geisse, who recently became chief of the bureau's new development section.

Oil Chemists to Meet

The division of petroleum chemistry of the American Chemical Society will meet in Cleveland, Sept. 10 to 14. Among the papers of automotive interest are Knocking Characteristics of Hydrocarbons, by W. G. Lovell, J. M. Campbell and T. A. Boyd, and A Method of Evaluating the Viscosity Temperature Characteristics of Oils. The former paper presents knock data on 103 pure hydrocarbons while the latter discusses mathematical methods of determining zero viscosity of an oil from its 100 and 210 deg. viscosities.

Copper License Plates

Michigan is experimenting with copper automobile license plates to determine how thin these plates can be made and yet be durable. Test plates have been made and are being tried on the automobiles belonging to Secretary of State Fitzgerald and other executives of the department.

Capt. Brewer Sails

Capt. R. W. A. Brewer, Huntington Valley, Pa., who has been engaged in the development of two-stroke cycle engines for several years, has sailed for Europe where he will spend most of September.

CALENDAR OF COMING EVENTS

SHOWS

American Transit Assoc., Cleveland, Ohio ..... Sept. 22-27
Cleveland (Automotive Service Industries) ..... Nov. 19-23
New York Automobile Show.... Jan. 5-12
Chicago Automobile Show.... Jan. 26-Feb. 2

MEETINGS

American Chemical Society, Cleveland, Ohio ..... Sept. 10-14
American Welding Society, New York City ..... Oct. 1-5

ANNUAL MEETINGS

Natl. Assoc. of Motor Bus Operators, Cleveland ..... Sept. 21-22
Natl. Safety Council, Cleveland, O.. Oct. 1-5
Institute of Traffic Engineers, Cleveland ..... Oct. 2-3
S.A.E. Annual Production Meeting Detroit ..... Oct. 10-11

CONVENTIONS

American Society for Metals, New York City ..... Oct. 1-5
American Transit Assoc., Cleveland ..... Sept. 24-27
International Foundry Congress, Philadelphia ..... Oct. 22-26
American Foundrymen's Assoc., Philadelphia ..... Oct. 22-26
National Foreign Trade Council, New York ..... Oct. 31-Nov. 2

EXPOSITION

Natl. Exposition of Power & Mechanical Engineering (Biennial) New York, N. Y. ..... Dec. 3-8

FOREIGN SHOWS

Paris Automobile Salon..... Oct. 4-14
London International Automobile Show ..... Oct. 11-20

The Horizons of B

LABOR continues to dominate—and disturb—the business picture. True to their threat the leaders of the cotton textile unions called their men out on the first of the month. Silk, rayon and wool workers are joining in the bid for shorter hours, higher rates of pay, brakes on further technological progress and certain general, more vaguely defined, social objectives. Francis J. Gorman for the workers and George A. Sloan for the employers seem to differ on the facts which allegedly provoked this latest engagement betwen labor and management.

Mr. Gorman cited instances of workers getting less than the code minima whereas Mr. Sloan claims that wages in the country's textile plants have increased more than 70 per cent over March, 1933. The issues, in spite of the cuttlefish fanfaronade of the labor leader, are reasonably clear and by this time quite familiar. The workers want present income maintained without working quite so hard or so long. They want the closed shop throughout the entire industry. This will place them in a position where they can exact in the form of wages all that the traffic will bear.

Higher Labor Costs Stimulate Use of Better Equipment

The strike leaders have made much of the "stretch out" and the hardship which it imposes upon the workers. Labor here again reiterates its age old objection to the introduction of machinery which increases the productivity per worker and thus, for a stated quantity of work, reduces the necessary number of labor hours. When the employers discovered that the acceptance of the code involved higher labor costs the incentive to introduce the latest automatic devices became marked.

It is merely an illustration of the well established economic principle of substitution. A rise in the cost of an article leads to the exploration of new economies and the substitution of material or devices which will obviate the rise. The fallacy of the make-work theory implicit in the code provision for shorter hours and higher wages lies in the naive confidence that a rise in the cost of labor will in no way affect the demand for labor. It is assumed that the opportunities for employment will in no way suffer if the cost of an hour's labor is raised from 60 to 90 cents.

Now that a year of the NRA has demonstrated beyond doubt that the initial reduction in hours is not an adequate specific for unemployment the labor unions abetted by the government are prepared to ask for another dose of the medicine whose impotence and mischief have been demonstrated.

Labor Would Veto Technological Improvements

In its attitude toward new devices labor has always been notoriously short-sighted. This is a fair generalization. If labor were granted the veto power in the introduction of equipment which displaces human energy the land would enter at once upon an era of stagnation, the principal victim of which in the long run would be the workingman himself.

This is well illustrated in a study, "America's Capacity to Consume," by the Brookings Institution (now on the press and to be distributed by the *Review of Reviews*) which shows a striking correlation between the growing productivity per worker and rising real income. During the first three decades of the 20th century the physical output per worker increased a little less than 40 per cent. In the same period real wages, i. e., the pay envelope, converted into goods and services at prevailing prices, increased 38 per cent. The hours of work in the interval were materially reduced. Where the average worker put in 100 hours in 1900 he labored only 87 in 1929. The point of all this is that the attitude of the textile workers toward a further introduction of automatic looms, if generally adopted by labor, will check the gratifying rise in living standards which accrued to the wage earner during the great era of technological progress. If the fate of the motor industry had been left to the discretion of labor it is certain that the automobile would have been a still birth.

Economic Progress in Reverse

There is another aspect of the textile workers' program which is alarming. The leaders demand a 30 hour week. The shorter week has powerful legislative (Wagner and Connery) and administrative (Perkins) support. The abundant life is the well articulated aspiration of the New Deal. "Plenty for all and poverty for none" is the slogan of Washington. Some of us tories have the curious, old fashioned notion that bread and perspiration are inviolable effect and cause. It is possible that some of the social alchemists on the Potomac have discovered a formula under which Uncle Sam can pull cake, champagne and flannel underwear out of silk hats while the worker spends his exalted leisure under the fig tree.

We deplore the necessity for calling attention to such an unpleasant matter just before an election but the

Business

by Joseph Stagg Lawrence

fact, convincingly attested by the record, is that better food, more clothing, finer homes and expanded pleasures require human effort to produce and distribute. Is it possible for the country to regain the living levels of 1929 on a 30 hour week? The output, material and intangible, of that year was the result of a 95 per cent employment of all eligible workers for an average work week of 51 hours.

Again we refer to the previously mentioned study. These scholars, who fortunately are not up for office this fall, say that it is impossible for the land to reproduce the 1929 flow of goods and services on a 30 hour week. In fact the general application of such a short week will turn back the hands of economic time to the beginning of the century and wipe out the progress toward higher living standards achieved in the 30 year interval.

One Way Contracts

The strike illustrates once more the privileged position of organized labor. In New Bedford, Passaic and numerous other textile centers employers had signed agreements with labor unions in the faith that this would assure continuity of plant operation for the life of the contract. These contracts have not been permitted to stand in the way of a response to the strike bugle. The law is unable to protect the contractual rights of the employers.

It does not seem to work the other way. A week ago a local magistrate in Gotham ruled that an employer could not dismantle his plant and remove himself to more reasonable labor climes to evade a contract with his workers. In another case a manufacturer of leather accessories, unable to renew a contract with labor on a satisfactory basis, decided to move to Massachusetts. This involved the violation of no agreement. Nevertheless the chairman of the local labor relations board, a lady with a highly developed social conscience, was gravely disturbed over the refusal of "runaway employers" to remain and "take it." Something, she felt, ought to be done about this.

Mr. Hopkins Speaks Impulsively

Harry Hopkins, outspoken chief of the Federal Emergency Relief Administration, is held in high regard by the administration. With his Utopian colleague, Guy Tugwell, he has just spent a week-end at Hyde Park helping the President draft a program of social legislation, covering old age, unemployment and relief. This will be waved before the next Congress until it has sufficiently satisfied the archaic constitutional requirement that such laws must originate in and be carefully considered by the legislative branch of the government.

In spite of his obvious favor on Olympus Mr. Hopkins has given the administration some awkward moments. Thus when Upton Sinclair rode the crest of primary victory in California as a self certified 100 per cent Democrat and New Dealer Harry extended arms of welcome toward the Pacific coast in unfeigned, boyish enthusiasm, Mr. Farley, other members of the political G.H.Q. and particularly the old line Democrats of California manifested profound chagrin. Mr. Sinclair has a past. He has been a Socialist. Without changing his convictions he altered the label on his theories and called himself a Democrat. Several hundred thousand Coast Democrats gave him the once-over and pronounced him an authentic representative of the New Deal.

The scouts of the party wired headquarters from the Coast that Sinclair might be a good horse in the primary, but could never win the main event. No one who voted for any of Mr. Sinclair's opponents in the primaries would vote for him at the final election. With the aid of some pencil and paper it was quickly determined that an official open welcome for Mr. Sinclair would have the same effect on the party's popularity later in the fall as an inadvertent intimacy with a pole cat. Thus the exuberance of Mr. Hopkins proved inept.

Taxpayers Subsidize Strikers

On another matter the candor of the FERA chief necessitated some pointed releases by other spokesmen of the administration. When a labor leader in Atlanta, one Mr. Googe, assured the union members that an indulgent government would place them on the relief lists as soon as they abandoned their jobs, Mr. Hopkins professed irritation. On being pressed he admitted that Uncle Sam would feed and clothe the distressed no matter what the occasion of their misfortune might be. He likewise conceded that the addition of a million strikers to the relief rolls might strain the exchequer. The implications of this confession were not lost upon the business men and taxpayers of the country. Donald Richberg has risen to qualify the commitments of Harry Hopkins. "The amount of Federal relief payments which can be attributed to strikes has been almost negligible," avers Mr. Richberg. There are some citizens who may accept that statement as an assurance that the government will not finance strikes.

Cooperative Fuel Research Committee Completes Second Series of—

Road Tests on D

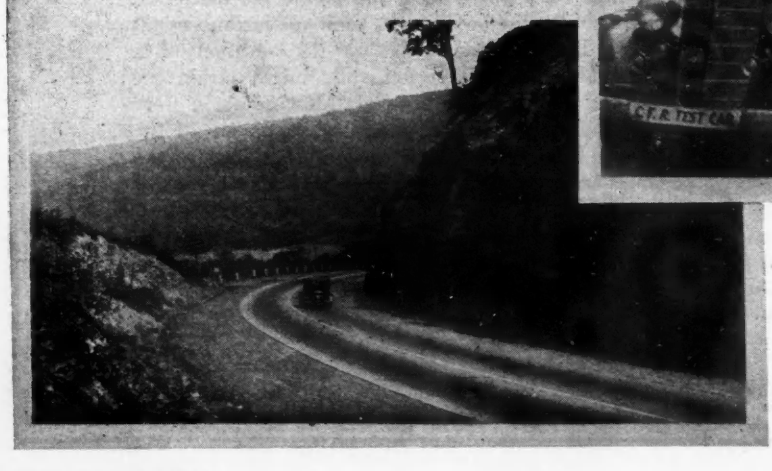
A COOPERATIVE road test designed to check the applicability of the C.F.R. Motor Method for determining the detonation characteristics of fuels and to show the way for future effective antiknock research came to a close at Uniontown, Pa., early in August. It was carried out by the Cooperative Fuel Research Committee and was participated in by twenty-five organizations in the oil and automotive industries in this and three other countries. An idea of the extent of the tests may be gained from the following figures concerning them: A total of 2516 gals. of test and reference fuels were rated in 19 cars, including 1934 models of 13 makes. Forty-one specialists were engaged in the tests for the better part of a month and a total of more than 50,000 car-miles was piled up.

New features not included in the similar series of tests carried out two years ago (see *Automotive Industries* of August 6, 1932) were level-road runs, so-called "blind tests", an investigation of the effect of the type of reference fuel on the road-knock ratings, variations in spark settings, blending of non-knocking test fuels with a low-octane gasoline to obtain a rating by extrapolation, observations with the electric ear, and high-speed, cross-country runs.

The 1934 cooperative road tests were the logical outgrowth of the similar project involving the correlation of laboratory and road knock ratings carried out two years ago. At that time a test engine, a reference scale, and a method of procedure had been developed for a laboratory test of the detonation characteristic of motor fuels and it was considered advisable to determine by road test whether this laboratory test really gave results that checked with those obtained in actual service. The tests held on Uniontown Hill in August, 1932, indicated the advisability of making certain changes, and these were incorporated in the Motor Method, which was subsequently approved by the American Society for Testing Materials. At a meeting of the Detonation Subcommitte held in October, 1933, the desirability of conducting further road tests was discussed, and the project was approved by the CFR Steering Committee a month later. In seeking a suitable location for the tests, ten different test hills were given consideration, but the choice fell again on Uniontown Hill.

The forty-one men forming the permanent personnel of the test corps gathered at Uniontown on July 9. They were divided into five groups, as follows: (1) observers for making knock ratings; (2) drivers of the test cars; (3) fuel blenders; (4) maintenance mechanics and (5) the Operations Committee itself which made assignments and plotted the data as it became available. However, all were afforded opportunity to engage in activity other than that covered by their original assignment, to enable them to broaden their experience in this line of experimental work.

All cars were 1934 models. They included three Chevrolets, three Fords and three Plymouths and one each of the following makes: Buick, Cadillac, Chrysler, Dodge, Graham, Oldsmobile, Packard, Pontiac, Studebaker, and Terraplane. The Chrysler, Dodge, Ply-



The upper stretch of Laurel Hill, near Uniontown, Pa., better known as Uniontown Hill

Maintenance Crew

Responsible for maintaining test cars in proper condition and adjustment — in charge of A. W. Macfarland (center), General Motors Proving Ground.

Left to right: Howard N. Evans, Phillips Petroleum Co.; Robert Mescher, Ethyl Gasoline Corp.; A. W. Macfarland, G. M. Corp.; R. C. Porter, Doherty Research Corp.; Harold Evans, Chrysler Corp.

Detonation Characteristics

Foreign Representatives

Left to right: R. Stansfield, Anglo-Persian Oil Co., Ltd., London; C. Bonnier, Office National des Combustibles, France; C. H. Sprake, Anglo-American Oil Co., Ltd., London; A. L. Helliwell, Imperial Oil Co., Ltd., Canada; Major N. Champsour, Air Attache, French Embassy; C. B. Veal, Secretary, Cooperative Fuel Research Com.

Group of Operations Committee

Analyzing data—in charge of J. M. Campbell, vice-chairman (center), General Motors Research Laboratories.

Left to right: J. R. Sabina, Atlantic Refining Co.; W. M. Holaday, Standard Oil Co. (Indiana); J. M. Campbell, General Motors Corp.; H. W. Best, Yale University; R. Stansfield, Anglo-Persian Oil Co. (London).

Fuel Service Crew

In charge of J. G. Cook (center), The Texas Co. Beacon Research Laboratory—responsible for blending and supplying test and reference fuels to cars.

Left to right: J. Bouma, Standard Oil Development Co.; J. G. Cook, The Texas Co.; H. G. Koch, Doherty Research Corp.

mouth and Terraplane had optional high-compression heads.

Experience in 1932 indicated the importance of not only keeping all the test cars in condition but maintaining a continuous and accurate record of spark settings and other factors which might affect detonation. Accordingly, special provision was made for taking care of this work in the 1934 tests by the appointment of a maintenance group.

The supply of test fuels consisted of 300 gal. each of seven commercially-marketed, branded fuels and 250 gal. each of nine unbranded fuels chosen to represent different types (Table I, p. 288).

The identity of the branded fuels was concealed throughout the tests. The identity of the non-branded fuels was revealed at the completion of specific portions of the test, but these fuels were recorded for the remainder of the tests. For reference fuels, Standard Oil of New Jersey Reference Fuels C-8 and A-3 were blended in varying percentages. Where reference fuels of higher octane number than the high reference fuel were required, the high reference fuel plus tera-ethyl lead was used.

In general the routine tests were carried out in accordance with the method worked out in 1932. That is, a rating was obtained for every fuel in every car, such rating consisting of the average of determinations made independently by at least two observers. Where the findings of two observers differed too widely, other observers were assigned to obtain additional ratings. The Operations Committee promptly analyzed all data as received from the observers and held frequent meetings of both its own members and of the test corps as a whole, to encourage discussion and hear suggestions.

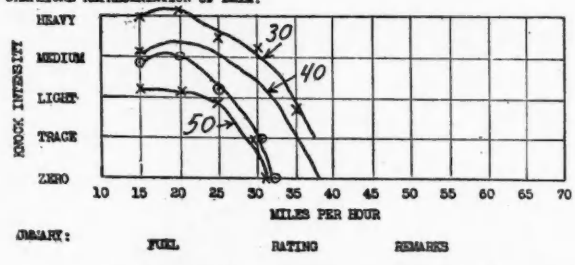
Each observer recorded his ratings on the Log Sheet shown in Fig. 1. He

C.F.R. ROAD TESTS

CAR _____ NO. 41 ODOMETER _____ SHEET NO. 1
DATE 7-16 AIR _____ BAROMETER _____ HUMIDITY _____
TEST CONDITIONS HILL COMPRESSION RATIO ____ SPARK STANDARD
OBSERVER JOHN DOE GROUP 125

FUEL	MILES PER HOUR 10	15	20	25	30	35	40	45	50	55	60	65	70	WATER TEMP.
50-C		L+	L+	L	T	O		33						160
50-C		L+	L+	L+	T	O		35						165
40-C		M	M+	M	L	T	O	40						160
40-C		M	M	M-	L-	T	O	36						165
30-C		H	H	H-	H-	L+	T							160
40-C		M+	H	M	M	T	O	38						160
40-C		M	M	M	L	T	O	37						165
#54		M	M+	L+	T	O		34						160
#54		M-	M-	L	T	O		31						165

GRAPHICAL REPRESENTATION OF DATA:



REMARKS:

FUEL	RATING	REMARKS
#54	43-C	

Fig. 1—Log Sheet on which each observer recorded his ratings

determined for the test fuel the degree of knock—heavy, medium, light, trace or zero—at speed increments of 5 m.p.h., and then ascertained what blends of the reference fuels C-8 and A-3 would be required in the car being used to give, first, a slightly heavier knock than that produced by the test fuel, and second, a slightly lighter knock. The rating of the test fuel expressed as the per cent of C-8 in A-3 would lie between these two. As shown on the Log Sheet, not only the test conditions and engine adjustments but also the atmospheric conditions were noted for each run.

These data were turned over to those in charge of charting and analysis. Two types of cumulative chart were prepared, as shown in Figs. 2 and 3. The first incorporated all the findings for all the branded fuels in one particular car. These were known as "Framework Charts" because the knock ratings at various speeds for the *standard* blends of reference fuel were first charted on them, as shown by the dotted lines in the fictitious examples given. The framework was filled in with ratings for the various test fuels which could then be compared not only with the reference fuels but with each other. In the hypothetical car represented in this chart, four fuels were found to knock with intensities lying between those of reference fuels containing 40 and 80 per cent of C-8 respectively; two fuels did not knock at all and one knocked so heavily that it could not be rated within the range of reference fuels used.

In the second type of cumulative chart, shown in Fig. 3, the ratings for an individual fuel in all cars were shown. At least two determinations were made for each fuel in each car, and sometimes three.

One variation from standard procedure is also indicated in Fig. 3, namely, change in the spark advance from the basic factory setting. Adidtional rules or changes in standard procedure were adopted for three reasons, viz., to increase the accuracy of results, to secure knock where it was not obtainable with the use of the standard procedure, and to ascertain whether the hill test represented conditions more or less severe than those encountered in actual service.

For the sake of increased accuracy it was ruled that all ratings for any one fuel in any one car must be within 10 per cent of C-8 of each other to be considered valid. Another innovation was the practice of running certain tests "blind," particularly on the level road, where acceleration is more rapid and readings therefore are more difficult to obtain. In such cases the identity of both reference and test fuels was concealed, so that the observer would not unconsciously be prejudiced in advance by his knowledge of the reference fuels' characteristic behavior.

Another project in the interest of greater accuracy, was an investigation of the effect of changes in the type of reference fuel on road-knock ratings. Two fuel elements were of particular interest, volatility and the characteristics of benzol. Two sets of special reference fuel were included in this investigation: first, blends of low antiknock reference fuel A-3 with a high antiknock fuel, straight run California gasoline (b-9); and second, blends of low antiknock reference fuel A-3 with a high antiknock fuel composed of equal parts of benzol and reference fuel C-8.

To secure knock under the test conditions with fuels of high antiknock value, the spark was advanced beyond the basic factory spark setting, but in all cases maintained within reasonable and practical limits of the spark advance for maximum power. In the cases of alterations in the spark setting, specific notation was made on the log sheets of the run. A second method was to blend the non-knocking fuel with a low-octane gasoline and to obtain a rating for the blend. Such blends will also be tested by the C.F.R. Motor Method for the purpose of securing correlation with laboratory results. At least three blends of the fuels were used, one of which was the blend containing the greatest percentage of the high antiknock fuel that could be rated in the car. The percentage of the high-octane gasoline was never less than 60. A curve of knock rating vs. composition,

Table I—Types of Test Fuels

b-1	Vapor phase—600 gal. 70 octane number	Pure Oil Co.
b-2	Liquid phase—800 gal.—68 octane number	Standard Oil Co. (Ind.)
b-3	A-7 plus b-1 for 65 octane number	To be blended at Chicago by Standard Oil Co. (Ind.), Sinclair and Pure Oil and shipped to Uniontown.
b-4	A-7 plus b-2 for 65 octane number	
b-5	b-3 plus T.E.L. for 70 octane number	
b-6	b-4 plus T.E.L. for 70 octane number	
b-7	b-2 plus T.E.L. for 75 octane number	
b-8	A-7 plus benzol for 70 octane number	
b-9	Straight run California (1600 gal.) 71 octane number	Standard Oil Co. (Calif.)

was then plotted and was extrapolated to indicate the approximate rating of the high antiknock fuel. However, even when both of these alterations in procedure were tried, certain cars could not be made to knock under any conditions. The rule requiring a rating to be made for every fuel with every car was therefore altered to a requirement for such rating with at least 15 cars.

For the level road ratings, which were thought to represent milder conditions than those of the hill test, a convenient course was laid out. The starting point was to be passed at 10 m.p.h., the speed being adjusted by means of the throttle and not the brake. The throttle was then to be rapidly and smoothly depressed to the full-open position, and, as the speed of the car increased, the following noted: (a) speed at which detonation starts, maximum intensity of knock, (b) speed at which such maximum intensity occurs, and (c) speed at which knock dies out.

Acceleration under full throttle was to be continued until a speed of at least 40 m.p.h. was reached, and, in cars showing a tendency to knock at high speed, until the knock died out or maximum car speed or safety required the closing of the throttle. In cases where a test fuel would not knock, the reference fuel blend containing the highest per cent of antiknock constituent that would give audible knock was determined and the test fuel reported as better than the reference fuel so found. The unbranded fuels were rated by this method.

For the tests at high speed specified in the program, cross-country runs were made, including both the negotiation of the hills characteristic of that part of the country and level road running. Such tests at sustained high speed represented conditions of greater severity than those encountered on the Uniontown hill.

The Test Corps also examined the possibilities of the so-called "electric ear," a detonation meter comprising a condenser-type microphone, suspended under the hood, to pick up the knock which is intensified by audio-amplification. Suitable filters eliminate the greater portion of the mechanical noises, and a volume control is used to suppress the knock coming through the instrument. A set of ear phones is attached to the output side for the use of the observer. Readings of a volume control dial, calibrated in decibels and so adjusted as to eliminate the knock on the output side, gave the intensity of the knock.

The opinion of the groups charged with investigating this instrument was that, while in the hands of an experienced user it is capable of greater accuracy than the aural method, considerable practice is required before that accuracy is attainable.

A report on the results of the investigation will be made by the Detonation Subcommittee at a later date.

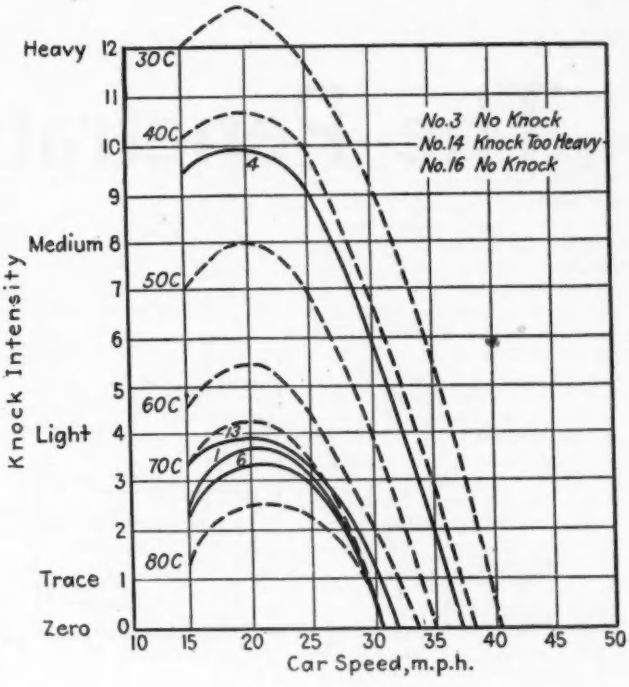


Fig. 2 — Sample of cumulative chart incorporating all findings for all branded fuels in one particular car

New Bearing Material

ANOTHER step in the manufacture of special bearings, bushings, fittings and small parts is made possible through the development of Permite Leaded Phosphor Bronze Bars, recently announced by Aluminum Industries, Inc., Cincinnati, Ohio.

Permite Bronze Bars are available in standard six foot lengths in diameters from 5/8" to 2", by 1/16" steps. All standard bearing bronze alloys may be supplied. Permite Bars are said to provide a stock of superior bearing qualities for screw machine or turret lathe production, as well as offering for the first time, a leaded bearing bronze in machine lengths.

The stock is said to possess exceptionally free machining qualities. Using tungsten carbide tools, it has been successfully machined at speeds in excess of 1500 surface feet per minute, without a coolant. A turned finish has been adopted; the better gripping it affords is said to make the free machining qualities completely available without excessive strain on the chucking mechanism. This combined with the easy machinability, will often permit production rates 50 per cent higher than those for drawn bar stock, it is claimed.

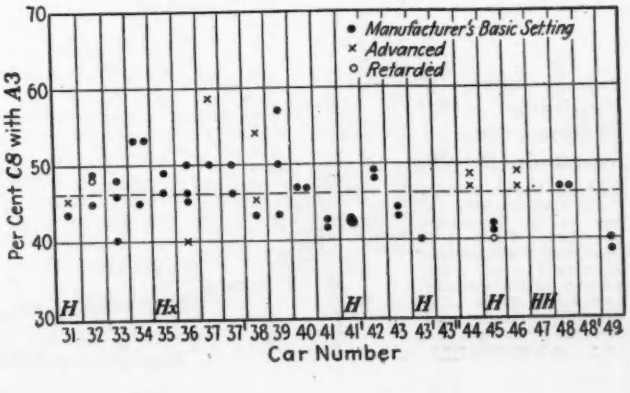


Fig. 3 — Another type of cumulative chart showing rating for an individual fuel in all cars

The Penetration of Oil Sprays in

By Dr. P. H. Schweitzer,
Associate Professor of Engineering Research,
Pennsylvania State College

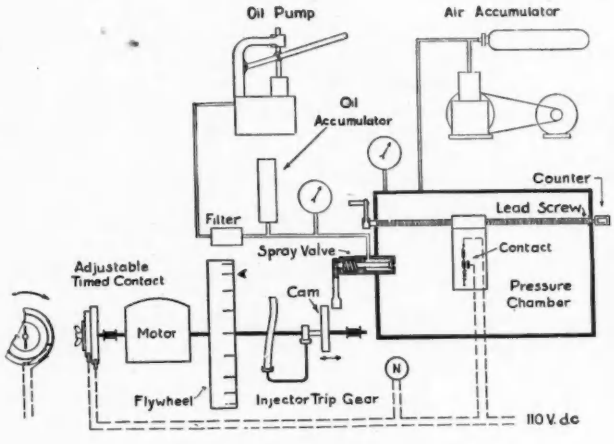


Fig. 1. Schematic Arrangement for Tip Penetration Tests

Spray contact and timed contact are in series with neon lamp (N) which glows only during the time that the two contacts overlap. If the spraying distance is greater than can be covered during the time before the timed contact breaks, the neon light ceases to flash.

HITHERTO-PUBLISHED investigations have dealt almost exclusively with the motion of the tip of the spray. High-speed photographs gave conveniently and accurately the contour of the spray and the position of the spray tip at short, consecutive intervals, and from the photographs the penetration and velocity of the spray tip could be determined.

In our laboratory we used a different method to determine the motion of the spray tip. A sensitive electric contact was closed by the spray impinging upon it, completing a circuit through a neon lamp. In series with the spray contact was a timed contact, the phase of which could be changed by turning a disk on the shaft which actuated the injection valve. When both the spray contact and the timed contact were closed simultaneously the neon lamp flashed. From this the time when the spray reached the spray contact could be determined.

Fig. 1 shows the general arrangement and Fig. 2 is a photograph of the pressure chamber and the injection mechanism. The oil is stored in the spray valve under pressure produced by the oil pump. Single injections are produced by the trip gear and permitted to impinge on a soft contact.

The time from the opening of the spray valve to the moment the spray tip reaches the contact is measured by the electric chronograph, which can be read accurately to one four-thousandth of a second. Distances traversed in successive time intervals were thus measured, and the results obtained when injecting into cold air at 200 lb. per sq. in. pressure are plotted in Fig. 3. Cold air at 200 lb. pressure has 15 times the density of atmospheric air, which corresponds to the average air density in a Diesel engine at the end of the compression stroke. Fig. 4 shows the effect of the density of the air in the chamber on a 4000-lb. spray. If the injection takes place into atmospheric air, the tip moves with almost uniform velocity for about 0.002 sec. In dense air the tip velocity near the nozzle is approximately the same as in atmospheric air, but the slowing-down process is much faster. It will be noted also that the penetration is still on the increase 0.032 sec. after the beginning of injection, although it is then quite slow. But from the Diesel-engine standpoint

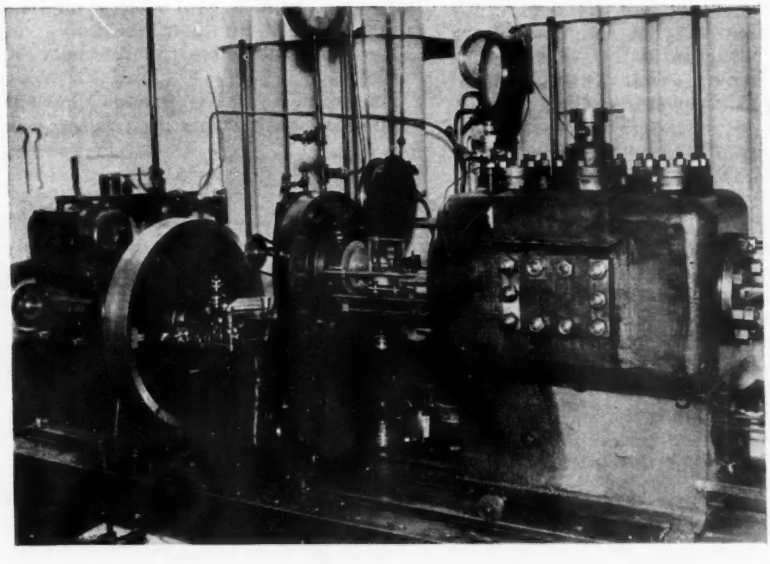


Fig. 2. Pressure Chamber and Injection Mechanism

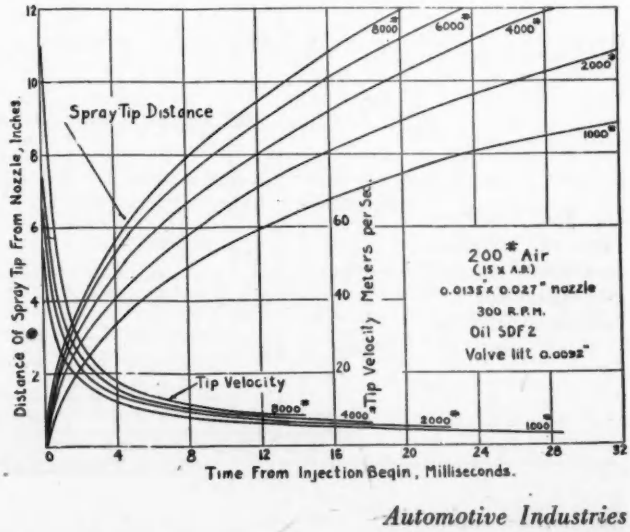


Fig. 3. Spray Tip Penetration in Air of fifteen times atmospheric Density

Curves show sprays from 1000 to 8000 lb. per sq. in. injection pressure. The oil used had a kinematic viscosity of 0.065 stokes and a specific gravity of 0.868. Tip velocities were determined by graphical differentiation.

in Dense Air *

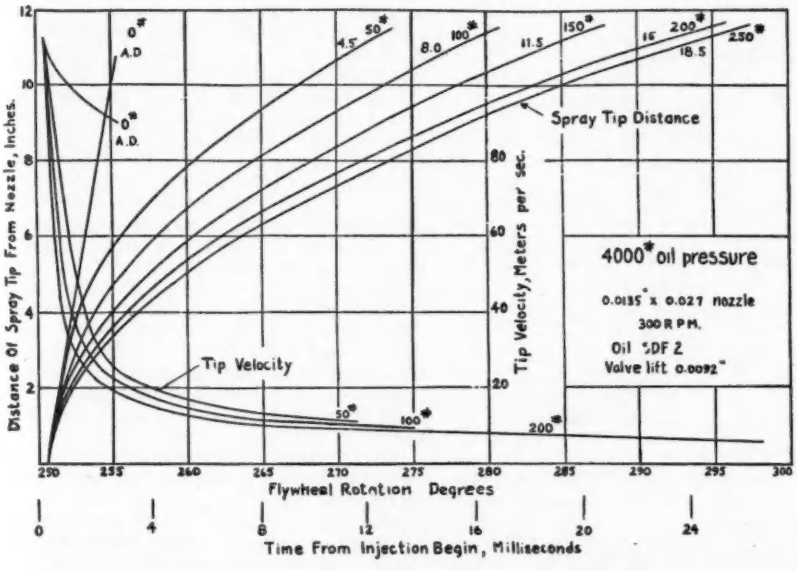


Fig. 4. Effect of Air Density on Spray Tip Penetration

Note the jump in tip velocity and spray tip distance between 0 and 50 lb. per sq. in. (4.5 times atmospheric density) air. The difference between 100 lb. air and 200 lb. air is insignificant.

the absolute maximum penetration is of little interest, because the combustion, and even the whole cycle, is over before the spray has developed its maximum penetration.

Data on tip penetration obtained by us are in substantial agreement with those of the N.A.C.A. (Miller and Beardsley, Spray Penetration with a Simple Fuel Injection Nozzle, N.A.C.A. Report No. 222), but the curves of Doctor Sass (F. Sass, Kompressorlose Dieselmaschinen, 1929) are much higher. He used a jerk-pump system, and during injection the pressure probably rose considerably above the valve-opening pressure, hence the high penetration values.

The above data describe the course of the spray tip as ascertained from experiments. This has frequently been taken as the motion of the sprayed liquid itself. The widespread confusion which exists justifies some explanatory comment.

When studying the mechanism of injection and ignition, attention should be centered on the individual droplets of oil. After traveling a certain distance the droplet either ignites in flight and then burns, or it hits a solid surface before it has an opportunity to ignite. The former is generally desired, while the latter is associated with incomplete combustion. The engine designer endeavors to create conditions such that the greatest possible number of the total oil droplets burn in an efficient manner. It is, of course, relevant to know where the oil droplets are in consecutive time intervals, with what velocity the individual droplets start their travel, how quickly they lose their velocities, how far they travel, how many of them are stopped, and how many advance against the air resistance.

A study of the spray tip alone will not furnish this information. The curves in Fig. 3 tell us where the farthest advanced droplets are at certain moments, but they don't tell us where the rest of the droplets are at that time or any other time.

The assumption is sometimes made (see F. Sass, Kompressorlose Dieselmaschinen, p. 68) that the spray tip represents the motion of the leading droplets, which have the highest velocities, and that the other droplets are trailing the leaders with somewhat lower velocities. This assumption would be correct if the leading droplets would remain leaders for any length of time. This is no doubt the case in vacuum, but not in dense air, nor even in atmospheric air. With air resistance present, the droplet that leads the spray at one instant is stopped the next by the air resistance. Other droplets coming from behind overtake the former leader, only to be stopped in turn very shortly afterward. While the particles move with great velocities, the tip of the spray moves comparatively slowly. The spray can be visualized as boring a hole in the air, and the tip velocity is nothing but the rate at which the hole in the air grows. How misleading it is to take the tip velocity for spray velocity, or something close to it, can be quickly realized if mentally we substitute rock for air. The oil spray in course of time will bore a hole in the rock. But the rate at which the depth of the hole increases will not be equal to the velocity of the oil particles.

More than anything else, it is the motion of the individual droplets that we are interested in. The true story would be obtained by observing the individual droplets. Unfortunately, this course is fraught with great difficulties. The next best thing is to ascertain the fate of the average droplet. This can be done to a certain degree by measuring mass effects.

Two methods were used at Pennsylvania State College: the ballistic pendulum to determine the mean velocity of the oil droplets by measuring the effect of their impact on a plate at right angles to the spray axis, and the tipping cup to determine what portion of

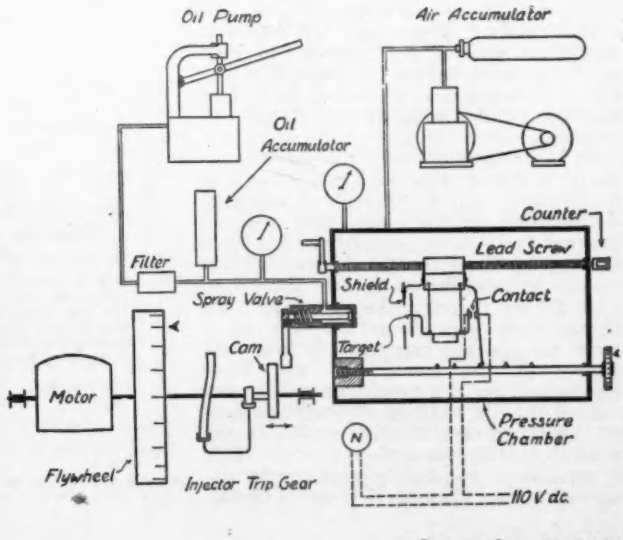


Fig. 5. Schematic Arrangement for Mean Velocity Tests

The spray delivers its momentum to the ballistic pendulum, the deflection of which is indicated by the adjustable gap of an electric contact.

* Paper presented at the Seventh National Meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers, State College, Pa.

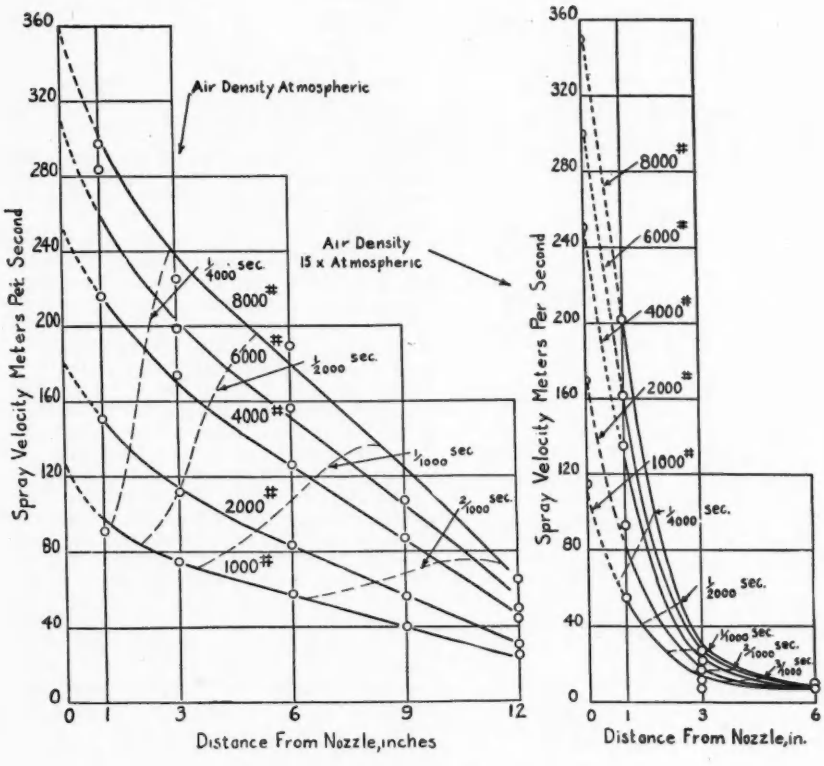


Fig. 6 and 7. Spray Mean Velocities

Velocities were determined in atmospheric air and dense air of 15 times atmospheric density. Constants are the same as in Fig. 3. The dotted lines indicate the calculated time the average drop requires to reach a certain distance after the beginning of the injection.

the total spray reached a certain distance from the nozzle.

The ballistic pendulum takes its name from its use for measuring the velocities of rifle bullets. In its simplest application the bullet of mass m impinges with velocity c on a freely suspended inelastic body of mass M. From the equality of momentums

$$m \times c + M \times o = (M + m)u$$

If the deflection of the pendulum is measured, c and u can be calculated.

A number of spray-velocity determinations were made with a ballistic pendulum on the assumption that the impinging mass m was equal to the mass of the oil, and that the mass of the entrained air that also impinges on the plate could be neglected. This assumption proved to be untenable.

It became evident that the ballistic pendulum cannot be expected to give useful results unless the impact of the air is eliminated or corrected for. The method finally adopted was found by accident.

In the course of some earlier experiments a shield plate with a 1¼-in. hole was placed closely in front of the pendulum disk, in the hope that it would prevent the greater part of the air from impinging upon the pendulum and yet would permit almost all of the oil to pass freely through the opening. This shield disk was found to act in a very unexpected manner. It not only prevented the peripheral air from impinging on the pendulum plate, but caused the air passing through the hole of the shield disk to exert a pull on the pendulum disk, instead of a push. This is similar to the fairly well-known observation that blowing through a thread spool will suck a name card to its face, instead of pushing it off. The probable explanation in both cases is that the deflected air expands and exerts a Venturi-like aspirating effect on the plate. No exact mathematical analysis was made of this phenomenon, but the following facts were established:

1. If the clearance distance between shield disk and target disk is small, the air exerts a pull on the target disk; if the clearance is large the air exerts a push on the target disk.

2. A position can always be found for the shield disk where neither a push nor a pull is discernible. The corresponding shield clearance is termed neutral clearance. With neutral shield clearance the air stream exerts zero force on the target disk.

3. The neutral clearance is practically independent of the air velocity and quantity as well as of the chamber pressure. At various blowing pressures, back pressures, nozzle sizes and nozzle distances the neutral clearance remained substantially the same.

These findings indicated that a shielded ballistic pendulum might be used for the determination of the true spray velocities of the oil, provided we could depend on the shield at the neutral distance to eliminate the impact of the entrained air while permitting all of the oil to impinge on the pendulum plate and to record the true oil momentum. In order to determine whether or not such a course is safe, a more detailed investigation was made on the suitability of the shielded ballistic pendulum for measuring spray velocities. The results of this investigation confirmed the belief that the shielded ballistic pendulum records the mean spray velocities in a reliable manner. The tests to be described were made on that basis.

The arrangement used for this series of experiments is shown schematically in Fig. 5.

The drive, nozzle, selector mechanism, oil supply, air supply, and air chamber were identical with those used in the tip penetration tests. The ballistic pendulum used for measuring the spray impact consists of a weight suspended by two 6-in. rods carrying a 5½-in.-diameter plate in front and an electric contact in the rear, as shown in Fig. 2. The weight can be changed so that convenient deflections of ¼ to ¾ in. are obtained.

One of the contacts is fixed on the swinging member and the other on the rigid carriage. The gap can be set from the outside through an adjusting rod and can be read in thousandths of an inch on the dial. Contact is registered by the low-tension neon lamp placed in series with the contact. Current is supplied from a 110-volt D.C. generator. In front of and concentric

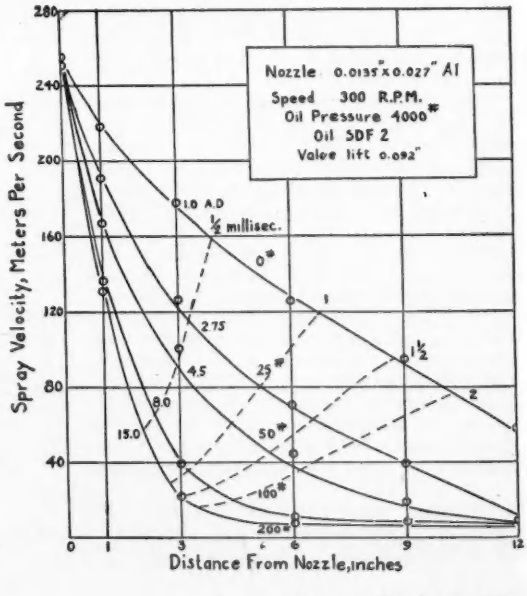
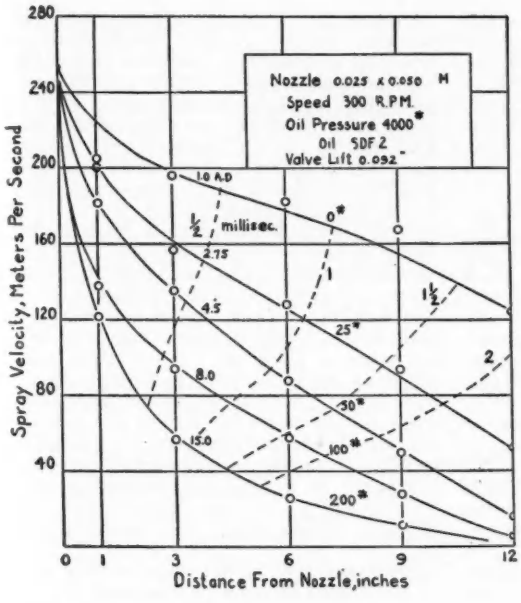


Fig. 8. Effect of Air Density on the Mean Velocity of Spray

It is to be noted that while at low densities the effect is very pronounced, in the region of interest the effect of air density is negligible. The dotted time curves are calculated.



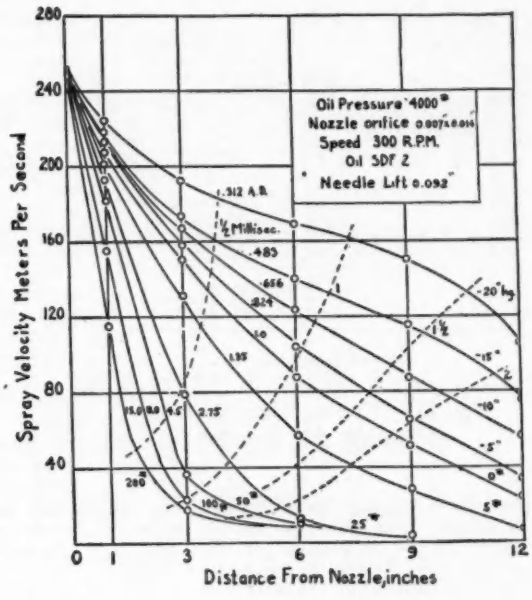


Fig. 9 and 10. Effect of Orifice Size on the Mean Velocity of Spray

Penetrating power of the small orifice spray is much smaller.

with the swinging pendulum plate there is a fixed shield plate 6½ in. in diameter and with a central 1¼-in. hole. The pendulum frame together with the shield plate and electric contacts is mounted on a carriage which permits axial motion inside of the chamber by turning the lead screw with an outside crank. The distance of the pendulum plate from the nozzle is read on the counter.

For measuring the weight of discharge of an injection, the spray is collected in an aluminum cup filled with cotton waste. The receptacle is weighed both before and after the injection, and the increment is determined.

Results obtained by the ballistic-pendulum method in one series of tests with a medium-size nozzle are plotted in Figs. 6 and 7, which represent injections into atmospheric air and into air of 15 times atmospheric density respectively. The graphs show that the initial velocity depends primarily on the injection pressure. The theoretical issue velocities indicated at zero distance check well with the extrapolated experimental curves. While the velocities at the start increase from 120 to 360 meters per second when the injection pressure is raised from 1000 to 8000 lb. per sq. in., it is significant that the high-pressure spray is slowed down so much more rapidly that after 0.002 sec. the velocities become practically equal. This means that the injection pressure affects the spray only for an extremely short time. The total penetration is virtually independent of the injection pressure. It is about 15 in. in atmospheric air, 9 in. in 100-lb. air and 6 in. in 200-lb. air, for the conditions indicated.

The effect of chamber pressure is made clear by Fig. 8, which represents a 4000-lb. spray injected into air of different densities. The dense air offers greater resistance to the spray, but above 100 lb. the difference becomes insignificant. Changes in the compression ratio of a Diesel engine between 12 and 17 have very little effect on the spray penetration.

On the other hand, by comparing Figs. 9 and 10 with Fig. 8, it will be noted that the orifice size affects spray penetration considerably. The 0.025-in. orifice produces a spray that maintains its velocity better and is, therefore, more penetrating than the 0.0135-in. orifice, and the spray of the 0.007-in. orifice is still weaker.

The orifice size offers the only effective means of controlling penetration, since the effects of oil pressure and air pressure are too small to be of consequence. Of course the penetration is influenced also by the viscosity of the oil, increasing rapidly with it,* but the viscosity cannot conveniently be controlled.

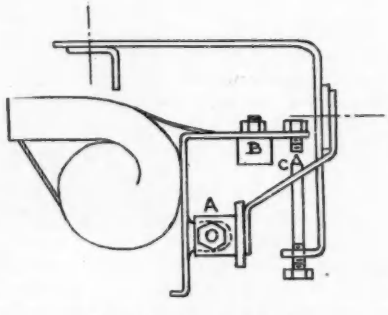


Fig. 11. Tipping Cup

The cup tips when oil exceeding a certain weight has been deposited in it. By counting the number of injections necessary to tip the cup, the amount of oil reaching a certain distance has been determined.

From the shape of the velocity-distance curves conclusions may be drawn as to the air resistance acting on the spray. Where the curve is a straight line or has an inflection point, like the 8000-lb. curve in Fig. 6 at 6-in. distance, the air resistance is directly proportional to the spray velocity. Where the curve is convex, as the 0-to-3-in. portion of the same curve, the air resistance varies faster than the velocity, and where the curve is concave, as beyond the 9-in. point, it varies less rapidly than the velocity.

A check on the results obtained with the ballistic pendulum, together with some additional information, was obtained by a device called a tipping cup, which is shown in Fig. 11. The spiral cup, shaped to receive the oil spray without splash, pivots on a cup-and-cone bearing A and is held in an upright position by the weight B which rests on an adjustable stop C. Filling up the cup gradually, a certain weight of oil will tip it and break an electric circuit. The tipping cup was mounted coaxially with the oil spray on the movable carriage and enclosed in the pressure chamber. By counting the number of injections necessary to tip the cup (indicated by a neon light going out), the amount of oil reaching a certain distance was determined. Then by outside manipulation the cup was set upright again and another reading taken.

Fig. 12 shows the results in air of 15 times atmospheric density. Comparing it with Fig. 7, a general agreement is noticeable. Of course, the tipping cup registers all of the oil that reaches the plane of its opening, regardless of how fast or how slowly;

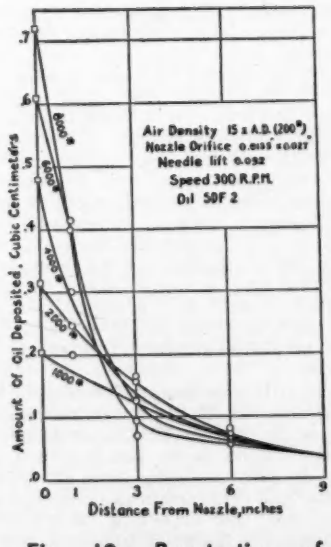


Fig. 12. Penetration of Spray Determined by Tipping Cup

Air density 15 times atmospheric.

* Pennsylvania State College, Engineering Experiment Station Bulletin No. 40, 1932.

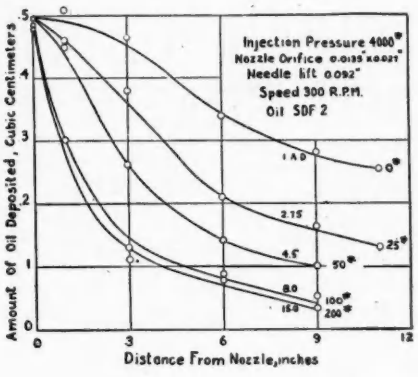


Fig. 13. Tipping Cup Tests at Variable Air Density

therefore, greater penetrations may be expected from the tipping-cup experiment. This is clearer from Fig. 13, which was plotted for different chamber air densities. Comparing it with Fig. 8, it will be noted that the decrease near the nozzle is less pronounced, as would be expected.

For setting instruments concentric with the spray, the concentricity tester (Fig. 14) was found convenient. It consists of a plate with a number of annular grooves about 1/32 in. wide, 1/32 in. deep and spaced 3/64 in. A soft tin foil, like that used for wrapping cigarettes, is placed on the plate and held by a spring clip. If the concentricity tester is placed in the geometrical axis of the spray nozzle, one or more shots against the tin foil produces an indentation in the foil which shows whether the spray is concentric or eccentric, and how much.

The concentricity tester can be used also for testing spray nozzles for orifice defects. A perfectly concentric spray is an exception, of course, but it has been shown by us by means of photographs that many commercial spray nozzles have an eccentricity greater than should be tolerated, as this condition greatly impairs the operation of the engine.

In the penetration tests the instruments were set in the actual spray axis, rather than in the geometrical axis of the orifice. The difference, however, was small.

In an oil burner or paint sprayer the spray is stationary, changing in space but not in time. In a Diesel engine we have intermittent sprays, a number of injections taking place every second. The spray cannot possibly be the same at the very beginning of injection as at a later period. It is of interest to know how long it takes for the spray to build up, to what degree the penetration is influenced by the engine speed or injection period, and how a spray of short duration compares with a stationary spray produced under identical conditions.

Some information on these questions can be obtained from the tip penetration data. It is obvious that as long as the tip penetration is on the increase, the spray is still building up. It is also obvious that this building-up period will depend on the injecting mechanism, specifically on the actuating cam profile.

In a jerk-pump system the injection pressure is produced during the injection, and the pressure is being built up while the spraying is in progress. In an accumulator system the fuel may be stored under pressure next to the spray valve, but usually a small space exists between the valve seat and the orifice, which is being filled up gradually even after the spraying has begun. Then it takes a certain length of time for the spray tip to reach a certain distance. But the building-up period is not over the moment the spray has reached the point under observation. With the progress of time the spray gets stronger and stronger until it completes the "airboring" process, from which time on it becomes stationary, unless it has been discontinued before.

During the building-up period, therefore, the following three processes take place: 1. Building up of pressure between valve seat and orifice; 2. Penetration of the spray tip; 3. Development of the spray itself. No. 1 is incidental to the particular injecting apparatus and is of no general interest. But No. 2 and 3 are aerodynamic phenomena and information on them should be of general interest.

The tests on tip penetration gave the sum of No. 1 and No. 2 with some natural overlap. Time is counted from the moment the first droplet leaves the orifice. After that the pressure builds up further behind the orifice and the tip advances, but the times involved by No. 1 and No. 2 cannot be separated. All that can be said is that the time necessary for a spray to bore a 3-inch hole in the air is less than the time measured for 3-inch tip penetration.

To eliminate the nozzle factor, the building up of the spray was studied with a spray stroboscope (Fig. 15). The stroboscope disk shields the spray for about 20 deg. cam rotation after injection begins, giving ample time for the pressure to build up. A slot then permits the spray to pass and impinge on the electric balance, which measures the dynamic pressure exerted by the spray. The oscillating weight is only 1.5 grams, and the balance therefore responds to pressures of extremely short duration. The duration of the spray can be changed by adjusting the width of the slot.

The test consisted in measuring the

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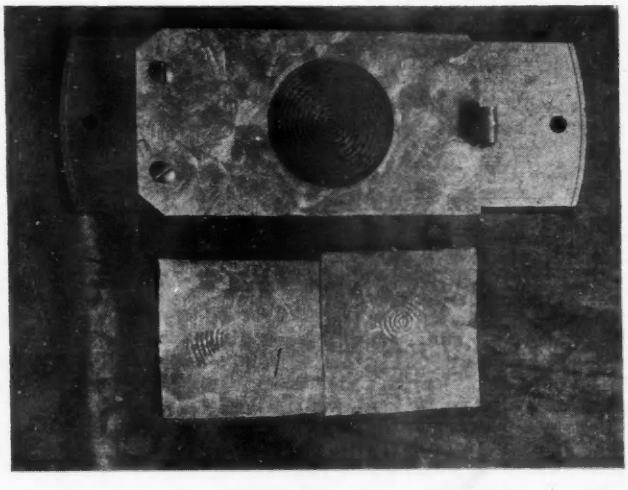

Fig. 14. Concentricity Tester

Indentation on a soft tin foil indicates the true direction of the spray core. Picture on the right shows a concentric spray, that on the left has a considerable eccentricity.

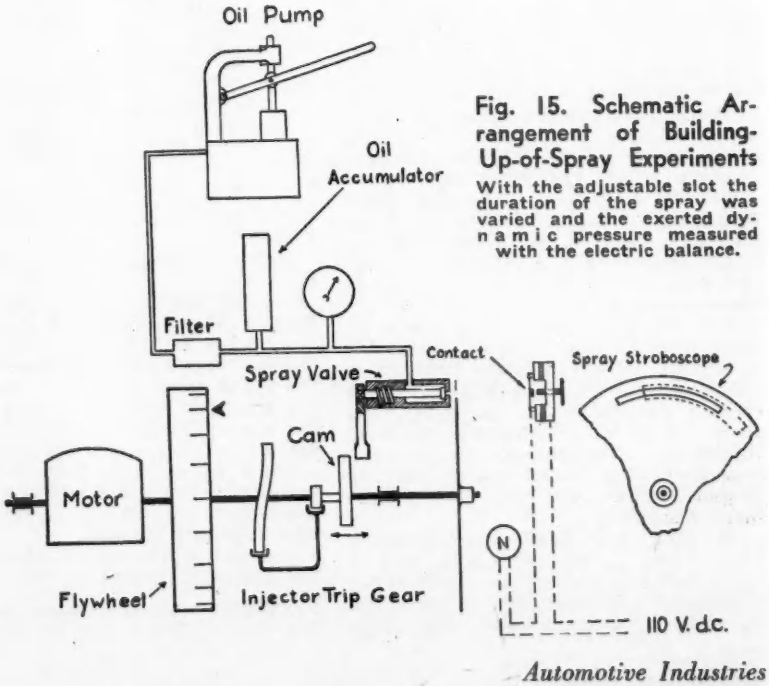

Fig. 15. Schematic Arrangement of Building-Up-of-Spray Experiments

With the adjustable slot the duration of the spray was varied and the exerted dynamic pressure measured with the electric balance.

How Riding Qualities Are Affected by Changing Weight Distribution

An analytical discussion of the effects of re-locating chassis units which streamlined bodies would bring

TWO problems are occupying automobile engineers at the present time. Streamlining has brought new body forms, and the new forms call for a redistribution of chassis parts, and particularly a relocation of the engine.

We therefore have to deal with new conditions of mass distribution. The engine may be placed at the rear of the chassis, or it may be placed over the front axle; in either case undeniable advantages result. It is apropos to study the effects of the new mass distribution on the riding qualities.

There are several possible methods of investigating the conditions resulting in a pitching motion. All being mathematical in character, they all naturally lead to the same final result; but as always in such cases, either a general theory may be applied to a particular case, or else the problem may be solved without recourse to any general theory, which amounts to revamping the theory to fit the particular case. In order to prevent misunderstanding, I consider it helpful to at least give an outline of the theory on which the developments to be discussed are based.

A study of the pitching motion of an automobile is nothing more than a study of the motion of a vibrating body having two degrees of freedom. The two fixed points of the system are the axles, and the two elastic constants are those of the chassis springs. There is only a single vibrating mass—the sprung mass of the vehicle.

It must be assumed that the axles are fixed with relation to the system of coordinates of the motion being studied, even though it is by axle motion that shock is imparted to the body. We will thus assume—and this assumption does not affect the calculations in the least—that the axles are mobile while a shock is being imparted to the sprung mass, and immobile during the development of shock motion. This assumption is valid because the time during which the shock is effective is considered to be infinitely short.

On the basis thus outlined we can apply the Lagrange theory. There is a Lagrange determinant which when equated to zero gives two roots which are the two principal frequencies of the system. Assuming that the center of oscillation and the amplitude of each of the vibrations have been calculated from the initial conditions, the frequencies thus obtained complete the data determining the nature of the resultant of the two superposed vibrations.

While this method gives the desired result, it is less direct than the one which I shall employ. which has the merit of being descriptive in character.

An equation given by me in 1928 is based on the assumption that the two axes of oscillation and the center of gravity of the sprung mass are in the same horizontal plane. This is not absolutely correct but is near enough to the truth for all practical purposes. It is the equation of motion of an oscillating body around an axis arbitrarily assumed to cut the x-axis. The consequence of this assumption is that all axes of oscillation are in the plane of the axles. The value of the frequency given by the direct formula is the resultant of the two principal vibrations of Lagrange in the state considered and defined by the condition that the instantaneous axis of rotation is at the point arbitrarily fixed by the variable x. It is evident that this formula, which is readily applied, must bring out the peculiarities which are generally revealed by the Lagrange theory.

Two of the axes of oscillation are stable and correspond exactly to the principal vibrations of the Lagrange theory. They correspond to the maximum and the minimum of the curve of frequencies as a function of x. The products of the roots x which determine these points are equal to the square of the radius of gyration. Thus the data of the two principal vibrations are obtained in a very simple manner. If the axes of oscillation of the two principal vibrations were the axes of percussion corresponding to the two axles, a pitching motion in accordance with these principal vibrations would be imparted to the vehicle, and if the damping stopped the motion between successive shocks, the vibration would be stable. But the curve shows that the frequency attains its maximum and minimum values when the axes of oscillation are elsewhere than in the vertical planes through the axles.

In order to deal fully with the problem it would be necessary to calculate the velocity with which the apparent axis of oscillation travels along the horizontal. However, this is a matter of no practical importance, because the damping of a good suspension system should be aperiodic, and in practice the effect is the same as if the axes of oscillation were fixed and located at the axes of percussion for the two axles.

The equation furnishes exact information of a theoretical nature. The square of the frequency, multiplied by the displacement of a point of the sprung portion of the vehicle, gives the acceleration of this point and, in a general way, $\omega^2 r$ represents both the

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The article appearing on this and the following pages is an abbreviated translation of a paper entitled "Galop des Voitures" (Pitching Motion of Vehicles) contributed by M. Georges Broulhiet to the French Society of Automobile Engineers. We are indebted to the author for furnishing us with a copy of the paper previous to its publication in France.

centrifugal acceleration of a rotary motion of radius r and angular velocity ω, and acceleration over a distance r of a vibratory motion of frequency ω, whatever the distance from the center of oscillation. (In this discussion ω represents the frequency of oscillation, not in complete cycles per second but in radians per second, so that ω is 6.28 times the cycles per second.)

The acceleration of the passenger is the product of ω^2 by the ratio of his distance from the axis of oscillation to the distance from the axis of percussion to the axis of oscillation. Therefore, acceleration of the passenger can be reduced either by decreasing his distance from the axis of oscillation or by increasing the distance from the axis of oscillation to the axis of percussion.

The acceleration of a point of the sprung body is the product of its vertical displacement by the ordinate ω^2 of the curve of oscillations. The vertical displacement itself is the product of the amplitude of angular displacement by the distance from the axis of oscillation, while the amplitude of angular displacement is a measure of the shock.

In order to show the need for calculation of the frequency of pitching motion, M. Broulhiet mentioned that with the considerable static deflections of chassis springs current at the present time, the pitching motions should have a duration of the order of one second, whereas sharp blows only one-half second in length are sometimes observed. As a matter of fact, the periods of oscillation around the axis of pitching motion are considerably shorter than those of strictly vertical oscillation.

The author states that in 1928 he gave the following equation for the frequency of pitching motion as a function of the position of the axis of oscillation:

$$\omega^2 = \frac{m_1 (l_1 - x)^2 + m_2 (l_2 + x)^2}{M (r^2 + x^2)} \quad (1)$$

This equation is nothing more or less than that of the frequency of a compound pendulum, the elastic restoring force of the pendulum figuring in the numerator and the moment of inertia in the denominator.

The equation for the time of a complete oscillation is generally written in the form

$$t = 2 \pi \sqrt{I/M_1}$$

and the frequency in radians per second is given by the relation

$$\omega = 2 \pi/t,$$

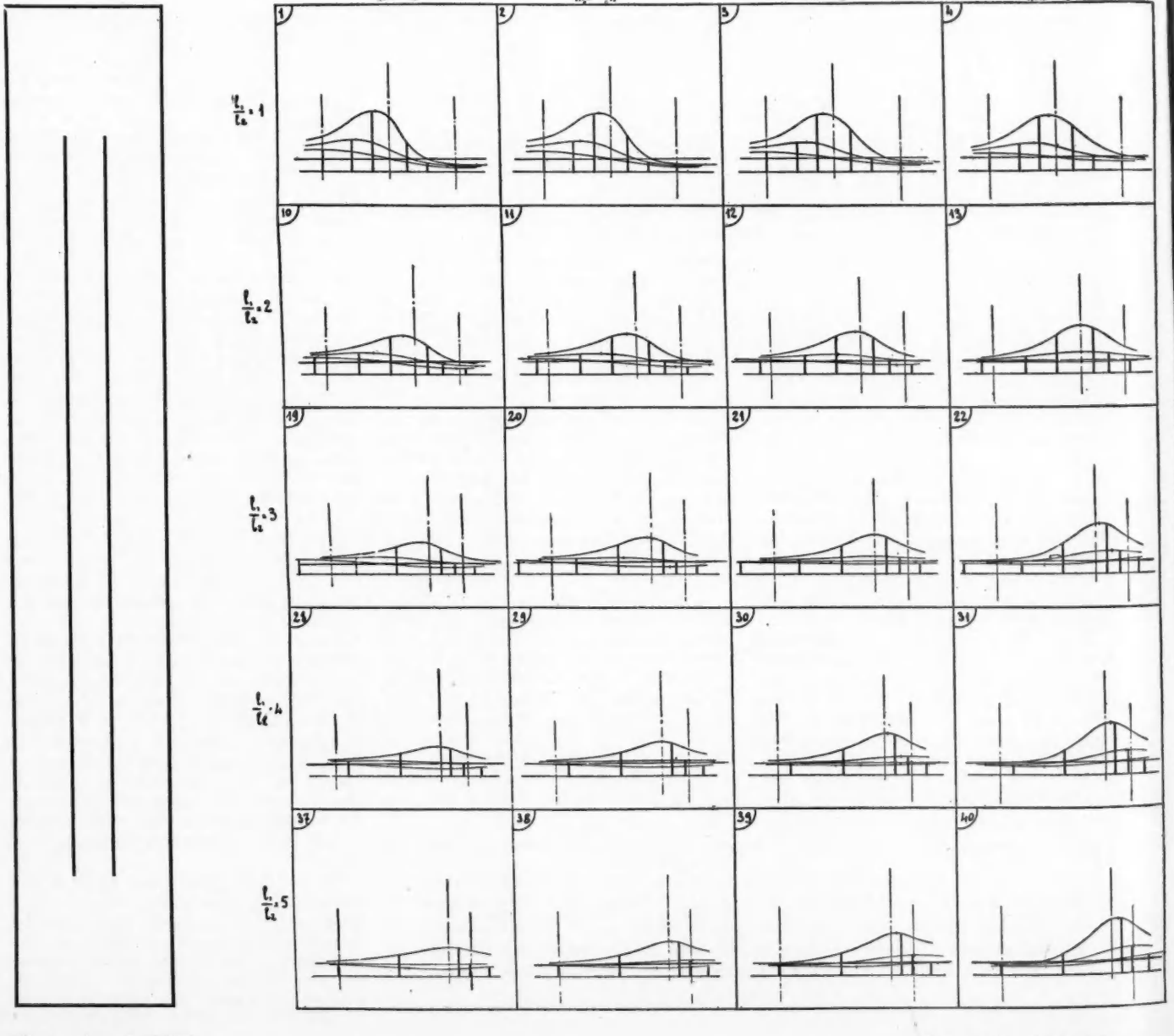
from which it follows that

$$\omega = \sqrt{(M_1)/I}$$

and

$$\omega^2 = M_1/I$$

The choice of this notation has two advantages: In the first place, it gets



Directions for Using Chart I

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Distances along the horizontal axis represent lengths measured along the longitudinal axis of the car, and the vertical distance from the horizontal axes to any point on any of the curves represents the frequency of oscillation squared of the sprung mass of the car around a transverse axis through the particular point on the longitudinal axis. The original curves were drawn to a scale of 1 mm. = 1 (radian per second)^2, so that the height of the ordinate in mm. gave the square of the frequency directly, but the chart has been reduced in the proportion of 2.8 :1, and the present scale therefore is 1 in. = 72 (radians per second)^2. This scale applies only to a car having a combined spring rate of 6000 kg. per meter (336 lb. per in.) and a sprung mass of 1,000 metric units (21,600 lb. or 56 inch-poundals). If the spring-rate and sprung-mass data of the car are different, the frequency of oscillation around any transverse axis is found from the Chart as follows:

First locate the particular section of the Chart which corresponds (most nearly), to the values of l_1/l_2 and m_1/m_2 for the car in question. Then choose the particular curve which corresponds most closely to the value of the radius of gyration r of the car in question. Determine the length of the ordinate of this curve at the point corresponding to the location of the axis of oscillation for which the frequency is to be found. The square of the frequency of oscillation of the sprung mass of the car around this axis is then

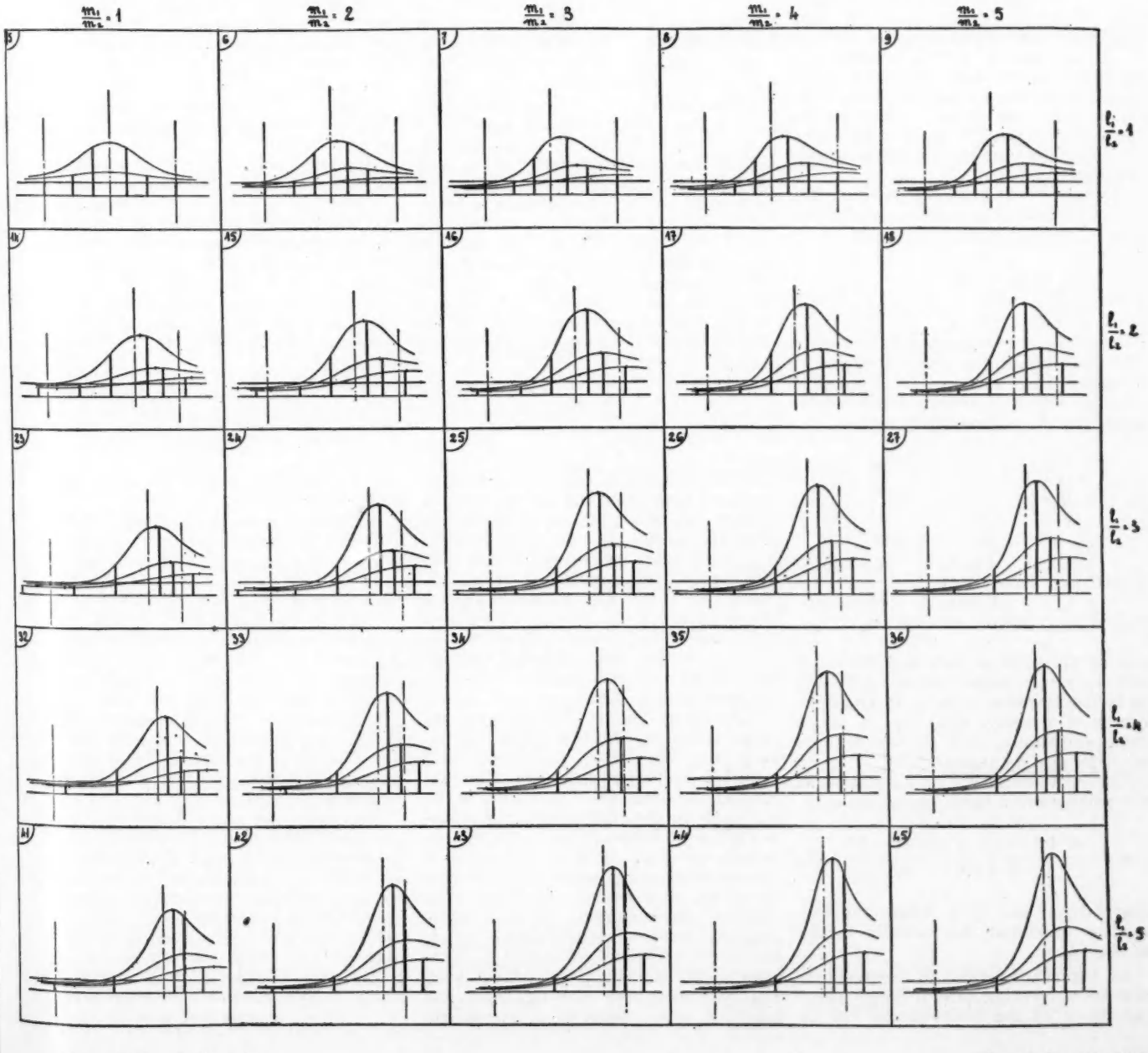
$$72\ L\ (m_1 + m_2)/0.085\ M,$$

where L is the length of the ordinate in in., m_1 and m_2 are the rates of the front and rear springs of the car in question, in lb. per in., and M is the sprung mass in inch-poundals (weight in lb. divided by 386). The coefficient 0.085 is the ordinate of the asymptotes of the chart as printed here.

The relation between ω^2 and the frequency of oscillation is given by the equation

$n = (60/6.28)\sqrt{\omega^2}$ cycles per minute, while that between ω^2 and the time of one complete cycle of oscillation is expressed by

$$t = 6.28/\sqrt{\omega^2} \text{ second.}$$



rid of the radical and the constant π and, besides, as has been shown, the acceleration, which is the important factor in studies of riding quality, is always proportional to ω^2

In equation (1),

ω is the frequency of the pitching motion in radians per second (cycles per second $\times$ 6.28).
m_1 and m_2 are the spring rates of the front and rear springs (lb. per in.).
l_1 and l_2 are the horizontal distances from the front and rear axle to the center of gravity (in.).
r is the radius of gyration of the sprung mass of the vehicle relative to its center of gravity (in.).
M is the sprung mass of the vehicle (weight in lb. divided by 386, because we are working with inch units instead of feet).
x is the horizontal distance of the axis of oscillation from the center of gravity (in.).

The problem consists in preventing the frequency from attaining anything like its maximum value.

If no damper (shock absorber) is included in the suspension, the equation defines the stability of form of the suspension (that is to say, the pitching properties) strictly as a function of the inherent properties of mass and elasticity.

Equation (1) gives a curve which has a horizontal asymptote corresponding to the equation

$$\omega^2 = \frac{m_1 + m_2}{M} \quad \ldots\ldots\ldots (2)$$

The curve represented by equation (1) has a maximum and a minimum corresponding to the roots of equation (3), in which the first derivative of equation (1) is equated to zero—

$$x^3 + x\left[\frac{m_1 l_1^2 + m_2 l_2^2 - r^2 (m_1 + m_2)}{m_2 l_2 - m_1 l_1}\right] - r^2 = 0 \quad \ldots\ldots\ldots (3)$$

Therefore, when

$m_2 l_2 = m_1 l_1$, that is, when $m_1/m_2 = l_2/l_1$

one of the roots is zero and the other infinity, one maximum or one minimum is in the transverse plane through the center of gravity, the other is at an infinite distance, and the curve does not intersect its asymptote.

The curve interests its asymptote at the point x given by the equation

$$x = \frac{m_1 (r^2 - l_1^2) + m^2 (r^2 - l_2^2)}{2 (m_2 l_2 - m_1 l_1)} \quad \ldots\ldots (4)$$

conventional car falls within the two sections extending horizontally across at the top.

As regards the ratio of front-spring rate to rear-spring rate, if we consider the limits of the conventional car to be represented by one carrying equal loads on both axles and having a front-spring rate five times as great as the rear-spring rate, and by another carrying equal loads on both axles and having equal spring rates at front and rear, we cover the range extending from column 5 to column 9, inclusive. All conventional designs therefore are included in the two horizontal sections at the top and in these in the five columns at the right.

As to the radius of gyration, the ideal value of which is equal to one-half the wheelbase, in conventional vehicles its value averages 0.65 per cent of the optimum. Therefore, in the ten cases in the chart which are representative of conventional vehicles, the actual curve of pitching frequency is located between the upper curve (corresponding to a radius of gyration of one-half the optimum) and the intermediate curve (corresponding to a radius of gyration of 0.75 the optimum). From this it is evident that the best means of slowing down the pitching notion consists in increasing the radius of gyration by every possible means.

By way of example, in Chart II, five different combinations of center-of-gravity location and ratio of front-to-rear spring rates, applicable to the 10-hp. Talbot car, are investigated.

For the combination of weight distribution and spring rates represented by Case I, the ordinate of the asymptote corresponds to a period of 0.85 sec., which is very good for the case of a pitching axis at infinite distance. But at the axes of percussion for the front and rear axles the period of oscillation drops to 0.50 sec. and 0.61 sec., which figures are not so good.

The same car when fitted with the standard axle, that is, without independent springing, with a front-spring deflection of 2 in. under static load, has an asymptote representing a period of oscillation of 0.58 sec., which is hardly sufficient. The maximum ordinate of the curve corresponds to a period of oscillation of 0.31 sec., this being the period when oscillation takes

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Directions for Using Chart II

The equation on which the chart is based contains five variables, namely, the radius of gyration, the horizontal distances from the center of gravity to the two axles, and the rates of the front and rear springs. These spring rates relate to the two springs on each axle, not the individual spring, the rate of which is only half as great.

The influence of the radius of gyration already has been made plain by calculating for each case the frequency curves for three proportional values of the radius of gyration, viz., one-half, three-eighths and one-quarter of the length of wheelbase. Actually the calculations were based on a length of wheelbase of 2 meters and radii of gyration of 1, ¾ and ½ meter, to simplify the computations. Since length enters into all terms of the equation in the second power, the frequency values given in the Chart apply in all cases where the proportion of radius of gyration to wheelbase length is the same. Thus in the case of a car of 120-in. wheelbase the three frequency curves apply to radii of gyration of 60, 45 and 30 in. respectively.

The sum of the spring rates $(m_1 + m_2)$ was taken as equal to 6 in metric units, also for the sake of simplicity of calculation. Spring rate is taken as equal to 100 divided by the flexibility in mm. per 100 kg. In English units this combined spring rate of 6 for front and rear springs is equal to 336 lb. per in.

The ordinate of the asymptote of the frequency curves is equal to the sum of the two spring rates divided by the sprung mass of the vehicle (weight in lb. divided by 386). Therefore, in order that the asymptotes of all of the frequency curves for a vehicle of given mass may coincide, it is necessary to keep the sum of the two spring rates constant.

When this condition is fulfilled, the aggregate spring weight of the vehicle is constant, and all frequency curves of the Chart correspond to the same amount of spring material.

There would have been a certain advantage in calculating the frequency curves for the optimum value of the ordinate of the asymptote, which corresponds to a cycle period of 0.65 second, but this would have made the calculations much more complicated.

Application of the formula to the calculation of the spring rates required for a particular car is illustrated by the following example:

We will assume that the sprung mass of the vehicle weighs 2200 lb. = 2200/386 = 5.7 inch-pounds or mass units. For the asymptote of the curve of vibration (frequency of straight up-and-down vibration) we will take $\omega^2 =$ 94 radians per second, which corresponds to a period of vibration of 0.65 sec. and a frequency of about 92 cycles per minute.

We then have

$m_1 + m_2 = 94 \times (2200/386) = 536$ lb. per in.

The value of l_1/l_2, that is, the ratio of the distance between the center of gravity and the front axle to the distance between the center of gravity and the rear axle, must be set in accordance with aerodynamic considerations, as for stability the center of

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gravity of the car must not be behind the center of air pressure or the metacenter, taking account of the possibilities of arranging the chassis components. In a front-driven car, for instance, the weight on the front axle may be made 55 per cent of the total, in which case

$$l_1/l_2 = 0.45/0.55 = 0.82$$

We will take $l_1/l_2 = m_1/m_2$, which, as we have seen, gives one of the best combinations of weight distribution and spring-rate proportion. In that case

$m_1 = (l_1/l_2)\, m_2 = 0.82\, m_2$

$m_1 + m_2 = 1.82\, m_2 = 536$

$m_2 = 536/1.82 = 294$ lb. per in. (rear springs).

$m_1 = 536 - 294 = 242$ lb. per in. (front springs).

These are the spring rates for the two springs on each axle. The rate of each spring is half as great.

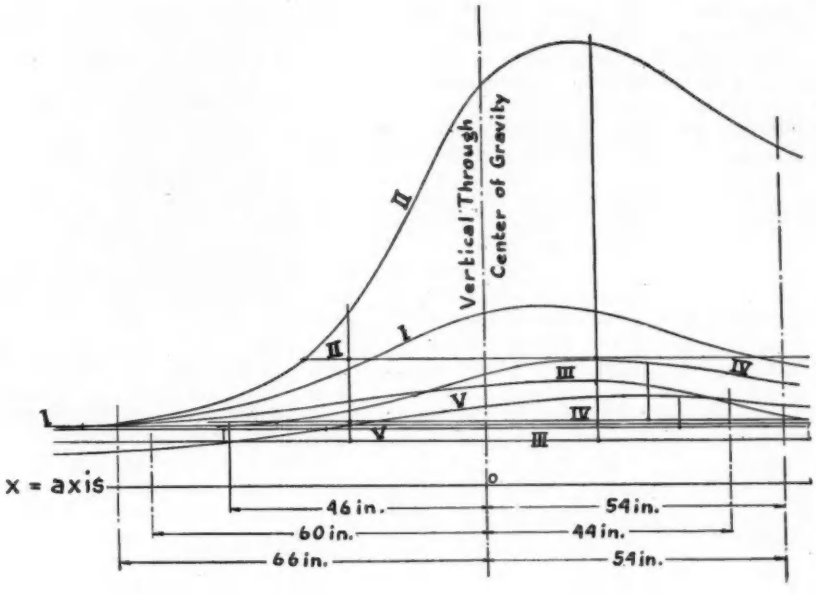
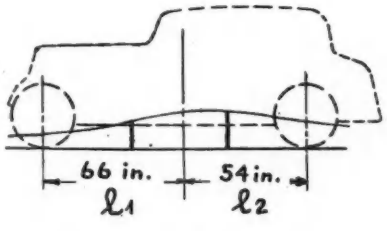


Chart II

I—10-Hp. Talbot car, independent springing, sprung weight with full load, 2960 lb.

$d_1 = 5.6$ in. $m_1 = 240$ $d_2 = 10$ in. $m_2 = 168$ $r = 35.8$ in.

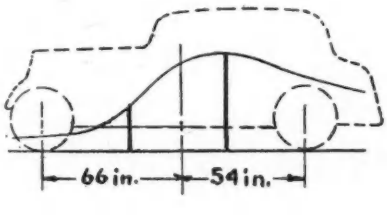
	ω^2		t		x		t
Asymptote		54.5		0.85			
Front wheels		57		0.83	Centers of	−19.7	0.50
Rear wheels		109		0.60	Percussion	+24.0	0.61
Max. (x = −8.3 in.)		161		0.49			



II—Same car with conventional axle.

$d_1 = 2$ in. $m_1 = 673$ $d_2 = 10$ in. $m_2 = 168$ $r = 35.8$ in.

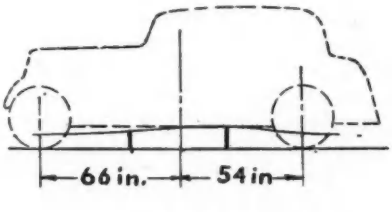
	ω^2		t		x		t
Asymptote		114		0.58			
Front wheels		57		0.83	Centers of	−19.7	0.32
Rear wheels		304		0.36	Percussion	+24.0	0.50
Max. (x = −15.7 in.)		400		0.31			



III—Same car with equal spring rates.

$d_1 = 10$ in. $m_1 = 134$ $d_2 = 10$ in. $m_2 = 168$ $r = 35.8$ in.

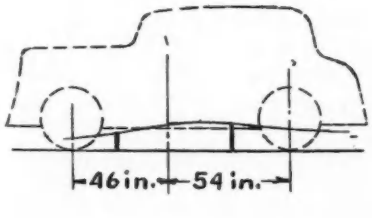
	ω^2		t		x		t
Asymptote		40.2		0.99			
Front wheels		57		0.83	Centers of	−19.7	0.64
Rear wheels		61		0.80	Percussion	+24.0	0.72
Max. (x = −19.7 in.)		91.5		0.65			



IV—Same car with front axle moved back.

$d_1 = 5.6$ in. $m_1 = 292$ $d_2 = 10$ in. $m_2 = 139$ $r = 35.8$ in.

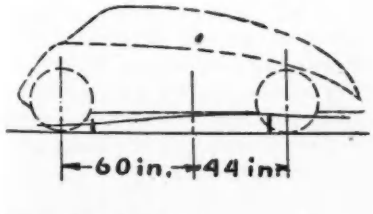
	ω^2		t		x		t
Asymptote		57.1		0.83			
Front wheels		54		0.85	Centers of	−28.4	0.60
Rear wheels		91.5		0.65	percussion	+24.0	0.76
Max. (x = −14.6 in.)		113		0.59			



V—Special car.

$d_1 = 6$ in. $m_1 = 213$ $d_2 = 10$ in. $m_2 = 174$ $r = 45$ in.

	ω^2		t		x		t
Asymptote		51.6		0.87			
Front wheels		33		1.09	Centers of	−34.2	0.71
Rear wheels		76		0.72	Percussion	+46.5	0.99
Max. (x = −24.4 in.)		79		0.70			



place around the center of percussion for the front axle. By comparing this figure with the corresponding one for Case I, it will be seen that independent suspension possesses an immense advantage over the conventional suspension as regards frequency of pitching motion around the axis of percussion corresponding to the front axle.

This supports the claim that independent suspension—since it permits of an increase in the static deflection of the front springs—is far superior to the conventional suspension, even aside from considerations of its effects on road-holding ability and tendency to shimmy.

Similarly, an increase in the static deflection of the front springs (with independent springing, naturally), up to the point where it equals the static deflection of the rear springs, offers considerable advantage. This is illustrated by Case III, where the time of oscillation around the axis of percussion rises to 0.64 sec. This is the combination employed by one large French firm at present.

Moving the engine forward in order to increase the moment of inertia is equivalent to moving the front axle back with respect to the front and rear ends of the vehicle. The limiting position for the front axle obviously is such that a tangent to the rear side of the front wheel is in line with the sloping windshield (Case IV). It will be seen that the periods around the centers of percussion remain substantially the same, although the front-spring static deflection has been reduced from 10 in. to 5.6 in.

Finally, Case V refers to a car made up of the same components but moved out farther toward the ends, the engine being located at the rear. In this case the improvement is still greater, because the period of oscillation around the axis of percussion has been increased from 0.71 to 0.99 sec., and this is accomplished without increasing the static deflection of the front springs beyond 6 in.

It may be argued that there is no advantage in increasing the period of oscillation beyond 0.65 sec., which is the figure aimed at by experimenters who have studied physiological reactions. If this is the case, then by increasing the radius of gyration of the sprung mass of the vehicle it becomes possible to reduce the static deflections materially below the figures usually demanded at present, and at the same time improve the riding qualities. From this it follows that the real criterion as to whether the engine should be placed in front or at the rear is which of the two arrangements naturally gives the maximum moment of inertia of the sprung mass.

From the foregoing one is led to the conclusion that the vehicle of the future will have the minimum wheelbase consistent with ability to open both doors. This suggests about 102 in., or some 20 per cent less than is used in the average present-day car.

An examination of Chart I shows that the best arrangements are those for which $m_1l_1/m_2l_2 = 1$, a condition which involves equal static deflections of front and rear springs. This result is of considerable importance. Having settled upon equal front and rear static deflections, one chooses the position of the center of gravity on the longitudinal axis of the vehicle by passing over the chart diagonally.

Aerodynamic theory indicates that the center of gravity should be at the center of air pressure. The center of pressure being always toward the front, the front axle should be the most heavily loaded, which condition in a high-speed vehicle necessitates front drive—at least where no stabilizing fin at the rear can be tolerated.

It will thus be seen that the region of optimum stability of form corresponds to a wheelbase of 102 in., a radius of gyration of 51 in., and a maximum period of oscillation of 0.65 sec., which represents a reduction of 20 per cent from the constants hitherto aimed at, the center of gravity being placed where required by the center of pressure.

If such a vehicle—without shock absorbers—is driven over the road, whenever the wheels on one axle strike an obstruction, an oscillation is set up around the axis of percussion corresponding to that axle. If this center of percussion is located at that distance from the center of gravity where the frequency curve of ω^2 shows either a minimum or a maximum, the oscillation will be stable. If the center of percussion is away from the axis of maximum oscillation, the axis will move gradually toward its stable maximum (or minimum) position, arriving there after a number of oscillations.

In practice the shock absorbers, and particularly those whose damping action varies with the speed, damp out the pitching motion during the first oscillation. Pitching therefore takes place solely around the calculated axes of percussion. In conventional vehicles the axes of percussion are located almost exactly in the region of maximum frequency. This condition has the effect that the oscillation becomes stabilized around the axis corresponding to the shortest period, which is bad indeed. The question then arises whether it is not possible, by exerting a restraining influence, to cause oscillations to start around a more favorably located axis when the wheels meet the obstacle.

Assuming that a fixed axis of oscillation is obtained which is in an undesirable location, it is an easy matter to calculate, by means of a formula, the vertical force to which this axis is subjected by the shock. It is also evident that if a constant-friction-type shock absorber is mounted, the friction of which is at least equal to the reaction on this axis, the oscillation will take place around the ball connector at the end of the shock absorber arm.

Calculations indicate that only a small vertical force is required—one which will not interfere with the proper functioning of the springs—to prevent location of the axis of oscillation near the maximum-frequency point of the curve.

Therefore, if the designer fails to obtain satisfactory riding qualities directly, he is in position to control the pitching motion by causing it to take place around a more favorably located axis, and one fixed in advance, by means of a light stabilizing damper (shock absorber).

Penetration of Oil Sprays in Dense Air

(*Continued from page 294*)

dynamic pressure of a spray of short, predetermined duration and increasing the duration by steps until the dynamic pressure showed no further increase. Fig. 16 shows the results for a 4000-lb. spray 1 to 15 in. long. Fig. 17 shows the time necessary for 90 per cent development of the spray at various distances from the nozzle. For less than 6 in. distance the time of spray development is less than one one-thousandth of a second, exclusive of the time of tip arrival.

These tests shed light on the question how engine speed or injection duration affects the spray. We expected that sprays of long duration would show a greater penetration and higher velocities than sprays of short duration, because the air is gradually set in motion and is expected to reduce the air resistance. However, the tests failed to show any noticeable difference between 50 r.p.m. and 500 r.p.m.; and, therefore, only tests made at one speed (300 r.p.m.) are reported. The injection period was 60 deg. cam angle. At 500 r.p.m. this is equal to 0.020 sec., but this is many times the time necessary to complete the development of the spray. This means that even at the highest speed the building up of the spray was over long before the injection was over. It is not surprising, therefore, that the high-speed and low-speed sprays showed no difference.

Highest-speed Diesel engines have injection periods of not less than 30 deg. crank angle at 1500 injections per minute. The minimum duration of the injection therefore is, 1/300 sec. Even this is much longer than the aerodynamic building-up period. If the building-up period is not much different in compressed air, we may conclude that the spray in an ordinary Diesel engine is not influenced by the duration of injection, and the penetration of a short, intermittent spray is the same as that of a stationary spray.

PRODUCTION LINES

New Lapper

Don't be surprised when a certain Detroit machine tool builder comes out with a lapping machine for transmission gears. It employs a novel principle, novel enough to get a clean bill of health in the Patent Office. The engineer tells us that the machine will correct tooth profile without affecting the accuracy of the involute form. A later development on this same machine, if it works out, will make the machine a grinder possessing a high order of performance.

Cast Wheels

High grade bronze worm wheels are being centrifugally cast by a well-known bronze specialist. They use a very simple set-up which is said to be doing an outstanding job not only in quality but by way of cutting cost. Incidentally they are turning out a mighty fine close-grained wheel that's very gratifying to the production machine shop.

Apprentices

Just a week ago a preliminary conference was held in the Middle West to set up agencies to control apprentice training. The conference was an outgrowth of an executive order by President Roosevelt. It's a praiseworthy effort to train youth for participation in industry and may do a job that industry has found difficult during the past few years.

About Welding

Peter Fassler whose name is well known for his remarkable work at Fisher body is working on a book dealing with electric welding. We saw it in manuscript. The book is an epic—thoroughly practical and yet sufficiently scientific to merit the attention of anyone in the welding field. His modus operandi is that many metal parts can be joined most economically by welding of some kind. He shows what can be done and what can't and why. It can't come out too soon to suit us.

Article 7-a

One of the effects of code hours under NRA is very little understood except by those who see it in operation. It's particularly tough on editors who travel hundreds of miles to see what's going on. We mean the staggering of hours occasioned by the restriction on hours of work. By 11:30 a. m. many plants stop the machines—and by 3:30 the plant is closed for the day. It's a herculean task to arrange production schedules these days.

On the Way

Among other things we find that a new company is about to announce an engine governor that should be of interest not only to factory engineers but also the great mass of truck fleet operators. Then too, we may hear soon of a tricky concealed hinge for passenger car bodies. It is simple and inexpensive. It is bound to be glad tidings to body designers and body stylists particularly.

Off the Record

What one of the best known master mechanics in Detroit thinks of machine tool prices will be an eye opener to many who read this. In a strictly informal conversation—under pleasing circumstances—he told us that most of the machine tools of the high production type are really worth about two or three times what they are sold for. The price is regulated to some extent by fierce competition and to some extent by what the traffic seems to bear. But actually the machine tool builder does so much real engineering and expends so much brains and accomplishes so much in cost reduction as to merit more than he dares ask in the way of compensation.

Plating Progress

You should take a look at the plating department recently installed by Packard in its new program. Not on our say so, but in the judgment of plating experts it represents the best plating shop in the industry. Aside from being a show place, it is mighty fine place in which to work—well lighted, well painted, free of fumes or odors. Completely automatic too, except in the chrome plating section, where hand dipping seems to be better suited to their needs.

Cleans Cores

One Detroit foundry has a very simple scheme for cleaning out cores in small gated castings. As you walk through you see a row of wooden barrels with water connections to each one. The idea is that when the flask is dumped, the gate is dropped into the barrel and contact with the cold water just explodes the core sand out of even the smallest bushings. This treatment leaves the parts surprisingly clean.

Eases Steering

Gemmer is very proud of its new replacement steering gear for Fords. It's intended for cars equipped with low pressure tires.—J. G.

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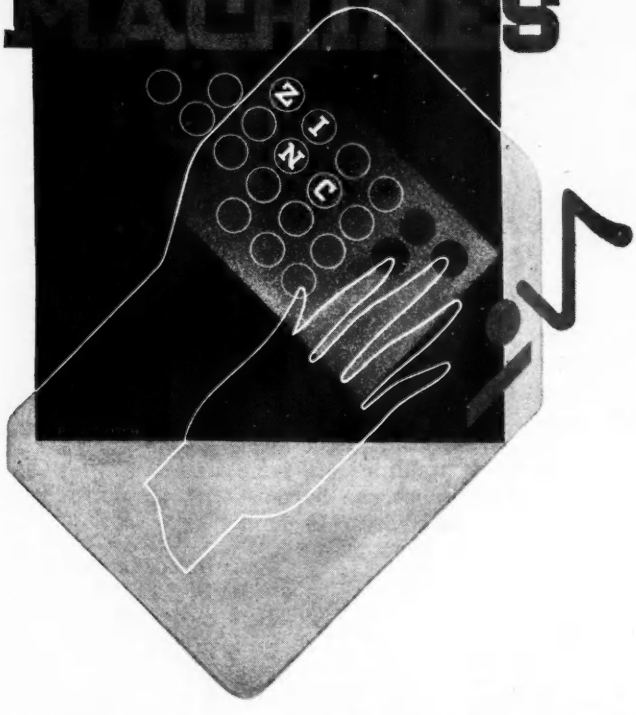
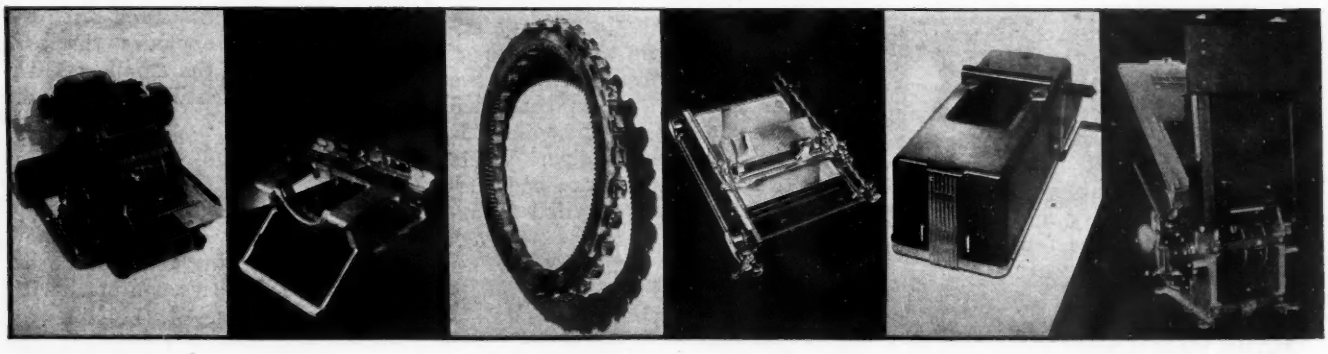
FOR BUSINESS MACHINES

DIE CASTINGS



Business machines... Machines of amazing intricacy and ingenuity—A vast amount of design and development work has been necessary to bring modern business machines to their present state of usefulness. But many of the production problems were solved, much precision machining eliminated, and stronger, more rigid construction achieved by the use of ZINC ALLOY DIE CASTINGS, made with Horse Head Special ZINC.

The die casting of printing wheels for check writers has long been recognized as the most economical method of manufacture. Typewriter frames are strong and much machining is eliminated when die cast. The sales register is practically a complete assembly of ZINC ALLOY DIE CASTINGS. In redesigning the Ditto Machine many die castings were adopted, reducing machining and assembly costs and gaining a superior surface for finishing.



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